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November 9, 2015

Zachary Simmons, Project Manager
U.S. Army Corps of Engineers, Sacramento District
1325 J Street, Room 1350
Sacramento, California 95814
zachary.m.simmons@usace.army.mil

Re: Comments on SPK-2008-00861 California WaterFix Permit Application

Dear Mr. Simmons:

Please find attached comments submitted on behalf of Save the California Alliance.

There is a list of attachments following the body of our comments, which contains hyperlinks to the first page of each attachment. We particularly commend to your full perusal Attachment Twelve, which is the flow criteria report addressed to the BDCP/California WaterFix as required by California Water Code section 85086(c)(1), and Attachment One, which is the Delta Independent Science Board's review of the California WaterFix SDEIS.

We believe that a comparison of the flow criteria report's recommendation for the minimum flows needed to restore the Delta ecosystem with the bypass flows provided by California WaterFix shows that WaterFix is not in the public interest.

We believe that the Delta Independent Science Board's review of the SDEIS establishes that preparation and recirculation of a second SDEIS is necessary before the Corps can begin evaluation of the project as required by 33 C.F.R. § 230.21 and 40 C.F.R. § 1502.9.

We appreciate the opportunity to submit these comments and thank the Corps for considering our views. We would particularly appreciate the opportunity to engage with the Corps in future public meetings and public hearings as explained in our comments.

Sincerely,

/s/Michael A. Brodsky
Michael A. Brodsky

COMMENTS OF SAVE THE CALIFORNIA DELTA ALLIANCE
SPK-2008-00861

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COMMENTS OF SAVE THE CALIFORNIA DELTA ALLIANCE
SPK-2008-00861

1. We Respectfully Request That The Corps Re-issue The Notice With A Clear Explanation Of The Corps' Process And Inclusion Of Documents Needed For Informed Comment.

The purpose of the Notice appears to be to solicit comments "to determine whether to issue, modify, condition, or deny a permit for this proposal [California WaterFix]." Notice 4. However, from what we can tell, the process appears to be a lot more complicated.

The Notice does not have a link to the project application and we could not locate the application elsewhere on the Corps' website. We found the California WaterFix Clean Water Act Section 404 Application (unsigned) ("Application"), along with a cover letter from Cassandra Enos, Program Manager, BDCP/California WaterFix to Michael Jewell, Chief, Regulatory Branch, Sacramento District, U.S. Army Corps of Engineers, dated August 24, 2015 ("Cover Letter"), on an external website.[1] The Application refers the reader to Appendix E of the BDCP/California WaterFix Recirculated Draft Environmental Impact Report/Supplemental Environmental Impact Statement ("SDEIS"). The Application states that Appendix E "provides an overview of the material needed for the Corps' permitting process under the authority of Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act and identifies the stage of the permitting process at which the material will be available." Application 28.

Appendix E is not referenced or linked on the Notice. It is unclear if Appendix E is a part of the Application. Appendix E, in turn, references a "white paper entitled 'BDCP: Permit Application Approach for CM-1,'" which was developed by the "USACE Sacramento District" in March 2013 ("*White Paper*"). SDEIS Appendix E E-2. The *White Paper* is not referenced or linked in the Notice and we have thus far been unable to locate it on the Corps' website. We did eventually obtain it from an external source. Appendix E further explains that "USACE and DWR have developed an approach to permitting the construction, operation, and maintenance of a new water conveyance facility pursuant to Section 404 and RHA Section 10." SDEIS Appendix E E-4.

Like all documents issued as a part of the BDCP/California WaterFix environmental review process, Appendix E, and its description of the Corps' permitting process, are incomplete and opaque. *See Review by the Delta Independent Science Board of the Bay Delta Conservation Plan/California WaterFix Partially Recirculated Draft Environmental Impact Report/Supplemental Draft Environmental Impact Statement,* September 30, 2015 (*ISB SDEIS Review*) (Attachment One).

Based on the foregoing, we respectfully request that the Notice be reissued and that it: 1) contain or attach or link a description of the entire Corps permitting process for California WaterFix going forward; 2) provide an anticipated schedule (subject to revision) of when all the missing detailed project information described below is

[1] As these comments were nearing completion, we obtained the signed application from a colleague who obtained it from the Corps in response to a FOIA request.

anticipated to be available; 3) based on anticipated receipt of the missing information, identify stages at which public comment will be open/re-opened and the focus of comments at each stage; and 4) attach or link all relevant documents including the Application (including future supplements), the *White Paper*, any "approach to permitting" that has been agreed upon between the Corps and DWR, the Corps' July 16, 2014, comments on the BDCP Draft EIR/S, and, on future notices, the missing project information as it becomes available.

We respectfully suggest that re-issuance(s) of the Notice is needed to comply with the requirement of 33 C.F.R. § 325.3(a) that the "notice, must therefore, include sufficient information to give a clear understanding of the nature and magnitude of the activity to generate meaningful comment," and that the documents and information requested above fall within any "other available information which may assist interested parties in evaluating the likely impact of the proposed activity if any, on factors affecting the public interest." 33 C.F.R. § 325.3(a)(13). The underlying purpose of these regulations is to provide a notice that generates "meaningful comment." Meaningful comment here is only possible if the public understands the permitting process that the Corps is undertaking and has ready access to all the relevant documents.

Reissuance of the Notice, and issuance of future notices, with a new comment period, under these circumstances, accords with the Corps' regulations for processing applications. "The district engineer will issue a supplemental, revised, or corrected public notice if in his view there is a change in the application data that would affect the public's review of the proposal." 33 C.F.R. § 325.2(a)(2).

We also suggest that a public meeting (perhaps in the form of a workshop) be held in order to have an exchange with the public about the process going forward and to formulate an approach to future public hearings on supplemental notices.

2. We Respectfully Request That The Corps Reject The Current Application, Without Prejudice To Its Re-Submittal, Because It Is Incomplete.

We believe that the application is incomplete and should be returned to the applicant, the notice re-issued as described above, and public comment opened when a complete application is submitted.

The White Paper describes a "complete application" as being submitted *after* the lead agencies issue their RODs on the project. This makes sense because at that time complete environmental documents and detailed project information should be available. However, the application has been submitted before any RODs have been issued, the environmental documents are incomplete, and much essential detailed project information is unavailable.

The *White Paper* lists, as necessary to a "Complete Application for CWA/RHA 10 DA Permit," *White Paper* 3, "detailed project information, including CM1 operations, in accordance with 33 CFR 325.1(d)." *Id*. However, CM1 operations are not now known at any level of certainty or detail. As USEPA recently noted, "the choices that will affect the operation of the tunnels, and thus the overall impacts of the project, will not be made until future regulatory actions are completed." Letter from Jared Blumenfeld, Regional Director USEPA Region 9 to David Murillo, Regional Director Bureau of Reclamation

Mid-Pacific Region, October 30, 2015, 4 ("*October 30, 2015, EPA Letter*") (Attachment Two). Current "[w]ater quality and aquatic life analyses in the SDEIS show that the proposed project may cause or contribute to violations of state water quality standards and significant degradation of waters of the U.S." *Id*. at 4.

Meaningful specifications for CM1 operations, and CM1's ability (or inability) to avoid violation of water quality standards and degradation of waters of the U.S., will not be available until 1) the California State Water Resources Control Board ("SWRCB") completes processing of the Clean Water Act section 401 permit for the project; and 2) the applicant completes and submits an adaptive management plan.

The *White Paper* anticipates that the section 401 permit will be issued before application is made to the Corps. Although 33 C.F.R. part 325 contemplates situations in which a 401 certification will be obtained after the application is submitted and before a permit is issued, here the information generated by the 401 process is essential to a complete application. Absent a detailed description of CM1 operations adequate to assess whether the project helps or harms the ecosystem and adequate to assess whether the project helps or harms water system reliability, the application does not contain a "complete description of the proposed activity" within the meaning of 33 C.F.R. § 325.1(d)(1). *See Also October 30, 2015, EPA Letter* 2 ("how freshwater flows through the Delta will be managed … is not described in the SDEIS and is, instead, deferred to future regulatory agencies [SWRCB]").

The applicant acknowledges the central role of adaptive management in defining CM1 operations. However, the applicant has not begun to develop an adaptive management plan for the operations of CM1 and appears unequipped to undertake this complex task. *See ISB SDEIS Review* 5 (applicant "unable to develop a substantive idea of how adaptive management would work for this project"). Absent a fully formulated adaptive management plan, evaluation of the impacts of the project on waters of the United States is not possible.

The *White Paper* also lists "a draft compensatory mitigation plan" as necessary to a complete application. *White Paper* 3. None was submitted with the application. Instead, the applicant's cover letter states that, at some point in the future, "DWR will submit a plan to the Corps that sets out an approach to mitigating" impacts. Cover Letter 4. The application also states that "DWR will submit to the Corps its approach to compensatory mitigation" at an unspecified date in the future. Application 22. The application does not satisfy 33 C.F.R. § 325.1(d)(7) ("application must also include either a statement describing how impacts to waters of the United States are to be compensated or a statement explaining why compensatory mitigation should not be required for the proposed impacts").

Although the "issuance of a public notice will not be delayed to obtain information necessary to evaluate an application," 33 C.F.R. § 325.1(d)(10), where the missing information makes the application incomplete it may be rejected. In accordance with the Corps' regulations for processing of applications, we believe that the application should be rejected and resubmitted with the needed information because the missing information will constitute a "change in the application data that would affect the public's review of the proposal." 33 C.F.R. § 325.2(a)(2).

3. We Respectfully Request That The Corps Exercise Its Authority Under 33 C.F.R. Part 230 To Require Preparation Of A Second Supplemental Draft EIS As Required By 40 C.F.R. § 1502.9.

With regard to the SDEIS, there is "substantial doubt as to technical or procedural adequacy or omission of factors important to the Corps decision." 33 C.F.R. § 230.21. This doubt is particularly acute with regard to the Corps' duty to assess and compare the range of alternatives available to the proposed project. As discussed below, there are unanalyzed alternatives that would avoid (or greatly reduce) discharge to waters of the U.S, would avoid impacts to historic districts and landscapes, would avoid impacts to navigation, and would avoid violation of water quality standards and degradation of aquatic resources of national importance.

The current SDEIS fails as an informational document and, in particular, fails with regard to treatment of alternatives. The SDEIS suffers from:

> overall incompleteness through deferral of content to the Final EIR/EIS (herein, "the Final Report"); specific incompleteness in treatment of adaptive management, habitat restoration, levees, and long-term effects; and inadequacies in presentation.
>
> ***
>
> The Current Draft lacks key information, analysis, summaries, and comparisons. The missing content is needed for evaluation of the science that underpins the proposed project. Accordingly, the Current Draft fails to adequately inform weighty decisions about public policy.

ISB SDEIS Review 4. Despite sustained outcry from the public and peer reviewers, the SDEIS still fails to comprehensibly compare the expected results of various courses of action:

> For over three years, the Delta ISB has been specifically requesting summaries and comparisons: first in June 2012, then in June 2013, and again in a review of the Previous Draft in May 2014 (footnote 1, p.1). Appallingly, such summaries and comparisons remain absent in the Current Draft. … Three years is more than enough time to have developed them.

Id. at 9.

With respect to the SDEIS's omission of a comprehensible alternatives analysis, which is essential to the Corps' duty to identify the Least Environmentally Damaging Practicable Alternative ("LEDPA"):

> The Previous Draft contained few examples of concise text and supporting graphics that compare alternatives and evaluate critical underlying

assumptions. Rudimentary comparisons of alternatives were almost entirely absent. The Current Draft retains this fundamental inadequacy.

Id. at 4. No peer reviewer has found the environmental documents to be adequate. The missing content is "critical to comprehending what is being proposed and its potential impacts." *Id.* at 10.

Under the circumstances, the applicant's promise that it "is in the process of developing information to support the analysis of alternatives pursuant to the Section 404(b)(1) Guidelines," Notice 3, is inadequate. We believe that relevant regulations mandate preparation and recirculation of a second SDEIS before the Corps begins evaluation of the project. "If a draft statement is so inadequate as to preclude meaningful analysis, the agency *shall* prepare and circulate a revised draft of the appropriate portion." 40 C.F.R. § 1502.9 (emphasis added). *See also Kettle Range Conservation Group v. United State Forest Serv.*, 148 F.Supp.2d 1107, 1120 (E.D. Wash. 2001) ("a draft EIS *must* be redrafted and reissued when it is so inadequate that it precludes meaningful analysis") (emphasis added). Awaiting preparation of the Final EIS is not a lawful option because "[t]hat will be far too late in the EIR/EIS process for content so critical to comprehending what is being proposed and its potential impacts." *ISB SDEIS Review* 10.

4. Applying The Section 404(b) Guidelines, The Application Should Be Denied.

a. All of 40 C.F.R. § 230.11(a)–(g) apply to the operation of CM1 as well as the direct effects of discharge.

Table 1 at Application 12 shows 141,675 cubic yards of discharge to waters of the United States at the intakes, and an additional 180,000 cubic yards of discharge at the intake end curves/walls. This discharge creates the fast land upon which the intake apparatus sits. The section 401(b) guidelines state that "[a]ctivities to be conducted on fast land created by the discharge of dredged or fill material in waters of the United States may have secondary impacts within those waters which should be considered in evaluating the impact of creating those fast lands." 40 C.F.R. § 230.11(h)(2). Upon considering the fill at the intakes, the Corps should consider the effect of the intakes in diverting water (the activity conducted on fast land) from the Sacramento River as a part of its direct 401(b) evaluation. Of course, the impacts of the change in point of diversion and operation of CM1 on California's entire water supply system and the Delta ecosystem are also considered under the Corps' public interest responsibilities pursuant to 33 C.F.R. § 320.4 and 33 C.F.R. § 323.6(a).

b. The applicant presents only one single-focus alternative through unlawfully narrowing the purpose and need of the project.

40 C.F.R. section 230.12(a)(3) provides that the application must be "[s]pecified as failing to comply with the requirements of these Guidelines where: (i) There is a

practicable alternative to the proposed discharge that would have less adverse effect on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences." An alternative "is practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purpose." 40 C.F.R. § 230.10(a)(2).

Here, the overall project purpose is aptly stated as follows:

> As stated in the SDEIS, the purpose and need for the WaterFix project, as was the case for the BDCP, is to advance the co-equal goals set forth in the Delta Reform Act of 2009. Those are (1) to provide a more reliable water supply for California, and (2) to protect, restore, and enhance the Delta ecosystem.

October 30, 2015, EPA Letter 2. *See Also* Cal. Water Code § 85054 ("'Coequal goals' means the two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.").

The applicant has repeatedly justified and described the project's overall purpose in the same broad terms summarized by the USEPA. "The overarching goals of the BDCP are to advance the restoration of the ecological functions and productivity in the Delta and restore and protect water supplies provided by the SWP and CVP … ." 2013 Public Draft BDCP 1-5 ("Draft BDCP"). Successful completion of the BDCP is intended to "afford regulatory stability with respect to the operation of the primary water delivery systems for the State of California." Draft BDCP 1-26. The BDCP "is intended to result in long-term regulatory stability for the state and federal water projects, while furthering the goals of the BDCP to restore and protect ecosystem health, water supply, and water quality." Draft BDCP 1-6. *See also Draft Implementing Agreement for the Bay Delta Conservation Plan* § 2.1.8 ("The overall goal of the BDCP is to restore and protect ecosystem health, water supply, and water quality within a stable regulatory framework.") (Attachment Three).

The range of alternatives analyzed in the SDEIS addresses only the unreasonably narrow characterization of the project purpose as the applicant provided it to the Corps and as it is restated in the Notice: "The applicant's stated overall project purpose is [to] construct and operate facilities and/or improvements for the movement of water entering the Delta from the Sacramento Valley watershed to the existing SWP and CVP pumping plants located in the southern Delta" in a manner that minimizes adverse effects of the project. Notice 2. Eight of the nine alternatives analyzed in the 2013 Draft EIR/S also focus on the construction of tunnels or canals to divert water from the north Delta to the existing pumping plants. Now that extensive habitat restoration has been dropped from the project, "[i]mplementing the conveyance facilities alone, as now proposed under Alternatives 4A, 2D, and 5A" is the range of alternatives analyzed in the 2015 SDEIS. In other words, the overall purpose as described by the applicant is to build CM1. Therefore, the applicant does not (and will not) provide alternatives to CM1. There is essentially only one alternative.

However, applicants are not free to provide a description of the underlying purpose of the project that "fulfill[s] their own prophecies, whatever the parochial impulses that drive them." *Citizens Against Burlington, Inc. v. Busey*, 938 F.2d 190, 196 (9th Cir. 1991). *See also National Parks & Conservation Ass'n v. Bureau of Land Mgmt.*, 606 F.3d 1058, 1072 (9th Cir. 2009) (summarizing 9th Circuit precedent to "forbid the [lead agency] to define its objectives in unreasonably narrow terms") (striking down lead agency's EIS because "[a]s a result of this unreasonably narrow purpose and need statement, the [lead agency] necessarily considered an unreasonably narrow range of alternatives"); *id*. at 1071 (stating that the court will "determine whether the [lead agency's] purpose and need statement properly states the [lead agency's] purpose and need … in a manner broad enough to allow consideration of a reasonable range of alternatives"). Courts reject unreasonably narrow interpretations of purpose and need that exclude viable alternatives suggested by commenters. *Center for Biological Diversity v. National Highway Traffic Safety Admin*., 538 F.3d 1172, 1219 (9th Cir. 2008) (holding that "[w]e also disagree with [the lead agency] that Petitioners' suggested alternatives would not be reasonably related to the project's purpose").

c. The project potentially provides only one benefit, avoiding smelt entrainment, that is outweighed by the project's adverse effect on Delta flows and resulting degradation of the aquatic ecosystem.

Because the applicant presents only one single-focus alternative, changing the point of diversion to the north Delta to avoid entrainment of the delta smelt, the project has only one reasonably predictable benefit: that it could allow for a reduction in entrainment of the delta smelt. Currently, the south Delta points of diversion create reverse flows in Old and Middle River ("OMR reverse flows") that entrain smelt. If diversion could be shifted to the north Delta points of diversion when smelt are present in south Delta, this entrainment could be avoided. This could allow exports to continue when they would otherwise be halted by federal Endangered Species Act requirements that pumping discontinue when smelt are jeopardized.

The applicant's originally proffered ability of north Delta points of diversion to help restore Delta flows has been proven false by the applicant's own modeling. The words "restore Delta flows" have taken on a new meaning for the applicant and now denote only a reduction in OMR reverse flows. *See, e.g.,* SDEIS ES-1–2 (describing project benefits as avoiding reverse flows, smelt entrainment, and concomitant restrictions on exports). CM1 neither enhances freshwater flows in the Delta nor contributes to ecosystem recovery. "We are concerned over the sole reliance on habitat restoration for ecosystem recovery, recognizing that existing freshwater diversions and significantly diminished seaward flows have played a significant role in precluding the recovery of Bay Delta ecosystem processes and declining fish populations." Letter from Jared Blumenfeld, Regional Director USEPA Region 9 to Will Stelle, Regional Administrator West Coast Region National Marine Fisheries Service, August 26, 2014 ("*August 26, 2014 EPA Letter*") (Commenting on 2013 Draft EIR/S) (Attachment Five). The elimination of habitat restoration in the new preferred alternative 4A only highlights the failure of CM1. Things have not improved as of the latest environmental review,

"because significant volumes of freshwater flows are diverted at the intakes resulting in less water that is also of lower quality downstream of the intakes." *October 30, 2015, EPA Letter* 3 (reviewing 2015 RDEIR/S).

Less water of lower quality downstream of the intakes will cause significant degradation of aquatic resources of national importance. Adverse effects include "loss of valuable aquatic habitat for many fish species in the Delta … [including] delta smelt, winter-run Chinook salmon, green and white sturgeon, stripped bass, and American shad," *October 30, 2015, EPA Letter* 3, "exceedances of chloride criteria near municipal water supply intakes … exceedances of salinity standard[s]" and other impacts. *Id*. These impacts might theoretically be mitigated or reduced by reducing diversions at the new intakes and "by appropriately timed increased flows." *Id*. However, the analysis that might support the applicant's reliance on altering CM1 operations has not yet been done and, as discussed in section 1 above, cannot be supported in the absence of an adaptive management plan. These impacts must therefore be considered adverse and unavoidable unless the applicant carries its burden to show otherwise. In addition, impacts GW-8, GW-9, AQUA-22, and AQUA-201 are admitted by the applicant to be adverse and unavoidable. Mitigation of impacts WQ-11 and AQUA-78 depend on an adaptive management plan that is impermissibly deferred and therefore must be considered adverse and unavoidable. Mitigation of impacts WQ-7 and WQ-32 are unsupported and must be considered adverse and unavoidable. *See Comments of Save the California Delta Alliance on 2015 SDEIS* 18–23 ("*Delta Alliance SDEIS Comments*") (Attachment 4).

We also join in the comments of others pointing out many other unavoidable adverse effects of Alternative 4A that degrade aquatic resources of national importance (and unsupported/flawed analysis in the SDEIS purporting to reduce these effects), including comments of Local Agencies of the North Delta and the National Resources Defense Council.

Taking a step back, common sense dictates that diverting up to 9,000 cfs from the Sacramento River at a point upstream of the Delta would exacerbate the primary problem in the Delta, which is lack of freshwater flows through the Delta. While providing relief from entrainment at the south Delta intakes is the only remaining veracious rationale for the project, depriving the Delta and the smelt of freshwater habitat actually harms the smelt as well as other endangered species. The "SDEIS predicts a loss of valuable aquatic habitat for many fish species in the Delta and upstream tributaries due to the combined effects of the WaterFix project, CVP/SWP exports," climate change, and upstream diversions. "Information presented in the SDEIS shows that the WaterFix project could reduce habitat conditions for delta smelt, winter-run Chinook salmon, green and white sturgeon, stripped bass, and American shad, and result in a decline of longfin smelt abundance." *October 30, 2015, EPA Letter* 3.

The applicant's promotional efforts, within its application and elsewhere, do not accurately characterize or place the project's reduction of OMR reverse flows in the context of the overall harm that results from CM1.

d. There are practicable alternatives to the applicant's single-focus "solution" that do not degrade the aquatic ecosystem.

There are practicable alternatives to the applicant's single-focus "solution" to water supply and ecosystem problems that "have less adverse effects on the aquatic ecosystem," 40 C.F.R. § 230.12(a)(i), and that would avoid discharge of dredged or fill material. *See* 40 C.F.R. § 230.10(a) ("no discharge of fill material shall be permitted if there is a practicable alternative" to the proposed discharge).

Virtually all stakeholders and the scientific community agree that a "portfolio" approach is required if we are to make meaningful progress in solving California's water problems and restoring the Delta, which are two sides of the same coin. A portfolio approach simply combines elements of conveyance with one or more elements of storage, groundwater management/recharge, and conservation.

In 2014, the BDCP lead agencies commissioned four eminent Delta scientists to author a report addressing the challenges facing the Sacramento-San Joaquin Delta in the context of solving the vexing problems of water supply and ecological degradation. *See* Louma, et. al, *Challenges Facing the Sacramento-San Joaquin Delta* (Delta Science Program 2015) ("*Delta Challenges"*) (Attachment Six). *Delta Challenges* concludes that Delta problems are too complex to be addressed by single-focus solutions, such as lone conveyance projects. "Single-focus problem solving can create unanticipated outcomes." *Delta Challenges* 9. Instead, "Simultaneous attention to a portfolio that includes actions like addressing overuse and misuse of water, and improving ground water management and storage, *should accompany any necessary water infrastructure adjustments*." *Id*. at 4 (emphasis added). *See also* Delta Stewardship Council, *18 Principles for Water Conveyance in the Delta, Storage Systems, and for the Operation of Both to Achieve the Coequal Goals*, *available at* http://www.deltacouncil.ca.gov/docs/delta-stewardship-council-october-22-23-2015-meeting-agenda-item-10-attachment-1-draft, last visited November 6, 2015 ("*18 Principles*") (Attachment Eight):

> The benefits of new Delta conveyance infrastructure should be maximized by integrating with new and expanded storage projects, implementing projects that increase water-use efficiency and conservation, improving groundwater management, and restoring the structure and function of some key Delta ecosystems. New Delta conveyance infrastructure by itself does not create any new supplies of water.

Id. at ¶ 4.

Practicable portfolio alternatives include integrating north of Delta offline storage ("NODOS") with a new point of diversion. The Sites Reservoir project is one example of NODOS that is well along in its feasibility studies and could add up to 1.4 million acre feet or more of water to current storage capacity. Water would be drawn from the Sacramento River only at times of peak flow and conveyed through existing local irrigation canals to a new storage facility. The stored water would be re-released back into the Sacramento River at times of low flow. This "new water" would flow downstream to the Delta. Part of it could be diverted by a new point of diversion and part of it could continue to flow downstream and through the Delta. This would increase

water available for export and increase freshwater flows through the Delta at the same time.

Because water would be available more consistently for export, new intakes for California WaterFix could be reduced from three to one, cutting impacts and fill discharge by two-thirds, and tunnels could be reduced from two 7500 cfs capacity tunnels to one 3,000 cfs capacity tunnel, substantially reducing (or even eliminating) the impacts from tunnel construction on wetlands and reducing the amount of excavated muck and its impacts. A new point of diversion and all the impacts from construction could be eliminated entirely because having additional upstream storage capacity could allow for release of water at times when smelt are not present at the south Delta points of diversion. Reoperation of Jones and Banks pumping plants in conjunction with NODOS (and other storage) could reduce or eliminate smelt entrainment. NODOS itself withdraws water from the system only at times of peak flow, so it should not have adverse impacts on downstream flow needs.

Preliminary information indicates that the single intake for the Sites project would be a small fraction of the size of one California WaterFix intake. A NODOS *Highlights Booklet* is attached (Attachment Seven). Due to file size, the NODOS Draft EIR (*available at* http://www.water.ca.gov/storage/northdelta/prelim_admin_draft_eir_index.cfm, last visited November 6, 2015) is not attached but is incorporated by reference as if fully set forth herein.

Moving forward with NODOS projects, and the Sites Reservoir project in particular, is urged by DWR (California Water Plan) and the Delta Stewardship Council (Delta Plan). The California WaterFix lead agencies have led the NODOS investigation. *See http://www.water.ca.gov/storage/northdelta/* (Reclamation and DWR stating that "NODOS would provide a robust set of benefits"). However, the project has been languishing for years and may never be built unless incorporated into WaterFix.[2]

Storage through groundwater recharge, creating new water through conservation, and implementing integrated water management are all also elements that could practicably be included in a feasible alternative. At the least, such an alternative would reduce impacts in the same ways described above, and could eliminate the need for discharge and wetlands impacts entirely.

Our July 29, 2014, comments on the BDCP Draft EIR/S ("*Delta Alliance Draft EIR/S Comments*") and our October 30, 2015, *SDEIS Comments*, which discuss available feasible alternatives in more detail, are attached hereto (Attachment Nine and Attachment Four). We believe that the LEDPA, which includes a portfolio element, is among these alternatives.

The applicant has been unable to justify omitting storage from the project other than by begging the question by stating that storage isn't a part of the project. *See* DWR, *Your Questions Answered* 8 (project does not include storage because "BDCP is a stand-

[2] The history of water projects in California is a history of broken promises for supplemental projects at a later date promised to secure approval for the present project. For example, SWP approval was premised on a promise to connect north coast rivers to the project. It never happened. If DWR wants Fix considered in the context of future storage, or its general commitment to a portfolio approach, approval of that storage or portfolio elements must be analyzed in a second SDEIS and approved as a part of the Fix ROD.

alone project") (Attachment 10); *see also Delta Alliance SDEIS Comments* § 3.C.3. (Attachment Four) (refuting applicant's arguments against storage).

5. Impacts On Navigation, Locke Historic District, And Historic Vernacular Landscapes.

a. Impacts at intakes.

There are significant multi-year (permanent) impacts to recreational boating due to construction activities at the intakes. The SDEIS describes construction-related cofferdams sticking out 60 feet into the Sacramento River at three locations over about four miles on the east bank of the River between Elk Slough and Snodgrass Slough. The SDEIS states that "warning signs and buoys would be posted upstream, downstream of, and at the construction sites" for the intakes. It also describes barge traffic servicing the intake construction sites. It is reasonably foreseeable that multiple barges with construction equipment and supplies will be anchored throughout this stretch of the river. Safety concerns will likely result in a five mile per hour zone along this entire stretch of river. Prudent boaters will feel compelled to slow to five miles per hour or avoid the area in any event.

This massive construction activity turns a four-mile stretch of the Sacramento River into a multi-year five mile per hour summer-season construction zone. The SDEIS states that in-water construction activity will be limited to the period between June 1 and October 31 each season in order to minimize impacts to fish species. However, that limitation concentrates construction activities in the prime summer boating season, which is when recreational boat traffic is intense and impacts on boating are the greatest.

If the three large intakes proposed in Alternative 4A are to be constructed, this effect is adverse and unavoidable. The only way to avoid this impact is to consider alternatives that do not involve three large intakes at this location. For example, an alternative with one 3,000 cfs intake would lessen the impact.

The SDEIS describes the cofferdams being replaced by permanent rock embankments when construction is completed. The drawings and description are very vague as to how far from the existing levees the permanent rock embankments will stick out and whether the rock embankments are underwater or rise to and above the surface. It is unknown whether promised "state of the art fish screens" will necessitate a five mile per hour zone. There is not enough information for the applicant to show that permanent impacts to recreational boating will not be adverse; its claims to the contrary are unsupported.

The intakes and associated industrial facilities, including gantry cranes looming over the river, scenic Highway 160, and the entire landscape, and forebays that look like sewage treatment plants (despite the applicant's best efforts to render them in a flattering light), alter a historic vernacular landscape by placing multiple large industrial facilities on an extensive stretch of peaceful boating and farming landscape. *See* Design Construction Enterprise, *Intake Design Review* (Attachment Eleven) (gantry cranes at page MWD004398).

The intakes and associated industrial facilities are also in close proximity to the town of Locke and the Locke Historic District, which preserves the cultural and aesthetic

history of Chinese immigrants to the Delta. The Locke Historic District is "the largest, most complete example of a rural, agricultural Chinese American community in the United States." National Park Service, *Locke Historic District*, *available at http://www.nps.gov/nr/travel/Asian_American_and_Pacific_Islander_Heritage/Locke-Historic-District.htm,* last visited November 7, 2015. The historic district exists in the context of the largely unaltered late nineteenth century landscape surrounding it. It is now, for the most part, as it was when the immigrants first settled here. The industrial forebay shown on sheet 6 of the figures attached to the Notice, as well as the dumping sites shown on sheet 6, are in very close proximity to the town of Locke. There are historic homes on the banks of the Sacrament River close to the intakes. Perhaps the only remaining example of a levee-side historic farmhouse is near one of the intakes. The nearby town of Hood is an iconic example of the Delta-as place. The intake facilities change the character of the entire area and present an unavoidable adverse effect on the historic values of the area. The intake structures are existentially incompatible with maintaining the historical sense of the area.

Within Alternative 4A, this is an adverse unavoidable aesthetic impact to boaters, users of scenic Highway 160, and the entire historic vernacular landscape that emanates from the Locke Historic District and the historically preserved character of the area. A Programmatic Agreement under Section 106 cannot mitigate or avoid these impacts after permits are issued because only an alternative plan for the project can avoid or lessen these impacts. One 3,000 cfs intake is likely the most that can be placed in this area without destroying the aesthetics and cultural significance of this Delta landscape. A better alternative, from the historic perspective, would be to avoid the area entirely because the applicant has chosen the most scenic and historically significant point in the Delta for its project.

b. Adverse effects and cumulative adverse effects of gate on Old River.

The new gate at Old River impacts recreational navigation. The presence of existing temporary seasonal barriers in this area does not lessen the impact (as claimed by the applicant); rather it increases the cumulative impact of barriers to navigation. The South Delta Temporary Barriers Project already blocks recreational boating on four waterways. These blockades are seasonal. Making the blockade at the head of Old River a permanent structure (gate) has a cumulative adverse effect. Multiple barrier and gate projects are being planned all over the Delta and present reasonably foreseeable additional cumulative impacts. For example, DWR erected a rock barrier at False River in the summer of 2015 and plans to continue to place rock barriers at False River to control salinity and allow exports to continue during times of drought. Gates are proposed at Three Mile Slough, and the SWRCB is encouraging the installation of other gates. Gates are planned or contemplated to address water quality issues in the San Joaquin River at Stockton. The "gating of the Delta" is one project and piecemeal approval of the head of Old River gate should only be made in the context of a cumulative impacts analysis for all reasonably foreseeable Delta gates or in the context of a Delta-wide programmatic EIS for gates.

An essential characteristic of boating in the Delta and the Delta-as-place is that it is free. Boaters enjoy the freedom of being able to travel by water through the maze of

sloughs without blockage. The Old River barrier and its cumulative counterparts invade that sense of wonder and freedom. These cumulative impacts are adverse and unavoidable. They should be analyzed. An alternative to the Old River gate, and the gate approach in general, should be considered.

Although of long duration, the Temporary Barriers Project does not represent a permanent infrastructural commitment. Likely, the applicant will want to replace the other seasonal barriers in the Temporary Barriers Project with permanent gate structures as well. This "gate creep" is alarming to boaters and should be the subject of a programmatic EIS, or at the minimum, a thorough cumulative impacts analysis.

6. CM1 Harms The Public Interest.

The Sacramento-San Joaquin Delta Reform Act of 2009, Water Code §§ 85000–85350 ("Act") directly addresses the public interest with regard to the reliability of California's water supply and its interrelationship with the Delta ecosystem. The pole star of the public interest with regard to the Delta is achievement of the coequal goals, which are "providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem." Cal. Water Code § 85054. This legislative determination of public interest is commensurate with the project's failed objectives, as discussed above in section 4.b. The determination of the people's elected representatives—speaking directly to the subject at issue here—is persuasive authority worthy of due consideration.

The foundation of the project was the restoration/creation of 90,000 acres or more of aquatic habitat, which was intended to qualify the project to meet the "gold standard" of a habitat conservation plan pursuant to section 10 of the Endangered Species Act. The hypothesis underlying habitat restoration on an unprecedented scale was that habitat could be substituted for flow. Proponents could export more water through CM1 *and* the Delta ecosystem would flourish even with diminished flows because the habitat-reformulated Delta would be an ecosystem that required less freshwater flow. The project failed in July of 2015 when that speculative and counterintuitive hypothesis proved false. They should have seen it coming: "One cannot substitute for the other; both flow improvements and habitat restoration are essential to protecting the public trust resources. *Flow Criteria Report* 7 (2010) (Attachment Twelve). What is left is a mega-diversion project with no habitat restoration, no HCP, no capacity to restore Delta flows, and the capacity to do great damage to aquatic resources of national importance. The project is now a single-focus approach to problem solving directed at avoiding smelt entrainment to allow for uninterrupted exports. The approach is antithetical to the *Flow Criteria Report's* identification of "the need for the BDCP to develop an integrated set of solutions, to address ecosystem flow needs, including flow and non-flow measures." *Id.* at 7.

Restoring Delta flows is an irrefragable and inherent sub-goal of restoring the Delta ecosystem. *See* Cal. Water Code § 85302(e)(4). Restoring Delta flows means allowing *substantially more freshwater to flow through the Delta.* The California Legislature directed the applicant to consider the *Flow Criteria Report*, which was legislatively commissioned. California Water Code § 85086(c)(1) provides that:

For the purposes of informing planning decisions for the Delta Plan and

> the Bay Delta Conservation Plan, the board [SWRCB] shall, pursuant to its public trust obligations, develop new flow criteria for the Delta ecosystem necessary to protect public trust resources ["flow criteria report"].

The flow criteria report concluded that restoring "75% of 14-day average unimpaired flow for January through June" was necessary to "halt the population decline and increase populations of native species as well as species of commercial and recreational importance." *Flow Criteria Report* 98. This flow criteria is "necessary to protect public trust resources … [because] flow modification is an action that can be implemented in a relatively short time in order to improve the survival of desirable species and protect the public trust resources … ." *Flow Criteria Report* 7.

The *Flow Criteria Report* repeatedly cautions the reader that it takes account only of ecosystem needs (as directed by the legislature) and cannot be implemented now because there would be no water left for export.[3] *See Flow Criteria Report* cover sheet and *passim.* It cannot be implemented today because we lack integrated storage and conveyance projects that achieve integrated water management. The California Legislature understood the need for integration. The Act calls for "new and improved infrastructure relating to the water conveyance in the Delta, storage systems, and for the operation of both to achieve the coequal goals," Cal. Water Code § 85304.

CM1 does not take us in the direction of restoring Delta flows. *See October 30, 2015, EPA Letter* 3 ("the WaterFix project does not propose additional flows in the Delta"). Alternatives that "could provide substantially more water for resident and migratory fish and provide benefits to aquatic life … were not evaluated as alternatives in the SDEIS." *October 30, 2015, EPA Letter 3*.

Under Alternative 4A, "the flexibility that Reclamation and DWR have to operate the system to ensure that water quality criteria are met will be seriously diminished, and the two agencies will have little room for error in operating the system to protect beneficial uses and achieve the coequal goals." *October 30, 2015, EPA Letter 3*.

Alternative 4A's single-focus problem solving is contrary to the public interest because rather than advancing the coequal goals, it makes it more difficult (if not impossible) to achieve them.

[3] It also repeatedly stresses that attention to other stressors, in addition to lack of freshwater flow, are needed in conjunction with improved seaward flows. However, lack of freshwater flow is the major stressor on the Delta ecosystem.

7. Conclusion.

In the interest of non-repetition, we adopt the comments of others pointing out deficiencies in the environmental documentation and adverse effects to aquatic resources of national importance. We also adopt the comments of others pointing out violations of state and federal law, including state and federal endangered species acts, state and federal clean water acts, and the federal Administrative Procedure Act. We thank the Corps for this opportunity to submit comments and for considering our views.

Sincerely,
/s/Michael A. Brodsky
Michael A. Brodsky

Attachments To Comments Of Save The California Delta Alliance SPK-2008-00861

List of Attachments

Attachment One:	ISB DEIS Review
Attachment Two:	October 30, 2015, EPA Letter
Attachment Three:	BDCP Draft Implementing Agreement
Attachment Four:	Delta Alliance SDEIS Comments
Attachment Five:	August 26, 2014 EPA Letter
Attachment Six:	Delta Challenges
Attachment Seven:	Nodos Highlights
Attachment Eight:	18 Principles
Attachment Nine:	July 19, 2014, Delta Alliance Comments
Attachment Ten:	Your Questions Answered
Attachment Eleven:	Intake Design Review
Attachment Twelve:	Flow Criteria Report

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September 30, 2015

To: Randy Fiorini, Chair, Delta Stewardship Council
Charlton Bonham, Director, California Department of Fish and Wildlife

From: Delta Independent Science Board

Subject: Review of environmental documents for California WaterFix

We have reviewed the partially Recirculated Draft Environmental Impact Report/ Supplemental Draft Environmental Impact Statement for the Bay Delta Conservation Plan/California WaterFix (herein, "the Current Draft"). We focused on how fully and effectively it considers and communicates the scientific foundations for assessing the environmental impacts of water conveyance alternatives. The review is attached and is summarized below.

The Current Draft contains a wealth of information but lacks completeness and clarity in applying science to far-reaching policy decisions. It defers essential material to the Final EIR/EIS and retains a number of deficiencies from the Bay Delta Conservation Plan Draft EIR/EIS. The missing content includes:

1. Details about the adaptive-management process, collaborative science, monitoring, and the resources that these efforts will require;
2. Due regard for several aspects of habitat restoration: landscape scale, timing, long-term monitoring, and the strategy of avoiding damage to existing wetlands;
3. Analyses of how levee failures would affect water operations and how the implemented project would affect the economics of levee maintenance;
4. Sufficient attention to linkages among species, landscapes, and management actions; effects of climate change on water resources; effects of the proposed project on San Joaquin Valley agriculture; and uncertainties and their consequences;
5. Informative summaries, in words, tables, and graphs, that compare the proposed alternatives and their principal environmental and economic impacts.

The effects of California WaterFix extend beyond water conveyance to habitat restoration and levee maintenance. These interdependent issues of statewide importance warrant an environmental impact assessment that is more complete, comprehensive, and comprehensible than the Current Draft.

Review by the Delta Independent Science Board of the

Bay Delta Conservation Plan/California WaterFix Partially Recirculated Draft Environmental Impact Report/ Supplemental Draft Environmental Impact Statement

September 30, 2015

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EXPECTATIONS FOR IMPACT ASSESSMENT OF CALIFORNIA WATERFIX

The Sacramento – San Joaquin Delta presents interconnected issues of water, biological resources, habitat, and levees. Dealing with any one of these problem areas is most usefully considered in light of how it may affect and be affected by the others. The effects of any actions further interact with climate change, sea-level rise, and a host of social, political, and economic factors. The consequences are of statewide importance.

These circumstances demand that the California WaterFix EIR/EIS go beyond legal compliance. This EIR/EIS is more than just one of many required reports. Its paramount importance is illustrated by the legal mandate that singles it out as the BDCP document we must review.

It follows that the WaterFix EIR/EIS requires extraordinary completeness and clarity. This EIR/EIS must be uncommonly complete in assessing important environmental impacts, even if that means going beyond what is legally required or considering what some may deem speculative (below, p. 4). Further, the WaterFix EIR/EIS must be exceptionally clear about the scientific and comparative aspects of both environmental impacts and project performance (p. 9).

These reasonable expectations go largely unmet in the Bay Delta Conservation Plan/California WaterFix Partially Recirculated Draft Environmental Impact Report/Supplemental Draft Environmental Impact Statement Draft (herein, "the Current Draft"). We do not attempt to determine whether this report fulfills the letter of the law. But we find the Current Draft sufficiently incomplete and opaque to deter its evaluation and use by decision-makers, resource managers, scientists, and the broader public.

BACKGROUND OF THIS REVIEW

The Delta Reform Act of 2009, in §85320(c), directs the Delta Independent Science Board (Delta ISB) to review the environmental impact report of the Bay Delta Conservation Plan (BDCP) and to provide the review to the Delta Stewardship Council and the California Department of Fish and Wildlife. On May 14, 2014, we submitted our review of the BDCP's Draft Environmental Impact Report/Draft Environmental Impact Statement (herein, the "Previous Draft"), which had been posted for review on December 9, 2013. This review[1] contained three main parts: an extended summary, detailed responses to charge questions from the Delta Stewardship Council, and reviews of individual chapters. Although the Previous Draft considered vast amounts of scientific information and analyses to assess the myriad potential environmental impacts of the many proposed BDCP actions, we concluded that the science in the Previous Draft had significant gaps, given the scope and importance of the BDCP.

The proposed BDCP actions have now been partitioned into two separate efforts: water conveyance under California WaterFix[2] and habitat restoration under California EcoRestore[3]. Environmental documents in support of California WaterFix (the Current Draft) were made available for a 120-day comment period that began July 10, 2015. The Current Draft focuses on three new alternatives for conveying Sacramento River water through the Sacramento – San

[1] http://deltacouncil.ca.gov/sites/default/files/documents/files/Attachment-1-Final-BDCP-comments.pdf
[2] http://www.californiawaterfix.com/
[3] http://resources.ca.gov/ecorestore/

Joaquin Delta. One of them, Alternative 4A, is the preferred alternative, identified as California WaterFix.

The Delta Stewardship Council asked us to review the Current Draft and to provide our comments by the end of September 2015. We are doing so through this report and its summary, which can be found in the cover letter.

The review began in July 2015 with a preliminary briefing from Laura King-Moon of California Department of Water Resources (three Delta ISB members present). The Delta ISB next considered the Current Draft in a public meeting on August 13–14 (nine of the ten members present)[4]. The meeting included a briefing on California EcoRestore by David Okita of California Natural Resources Agency and a discussion of the Current Draft and California WaterFix with Cassandra Enos-Nobriga of California Department of Water Resources (DWR) and Steve Centerwall of ICF International.

The initial public draft of this review was based on our study of Sections 1-4 of the Current Draft and on checks of most resource chapters in its Appendix A. This public draft was the subject of a September 16 meeting that included further discussions with Cassandra Enos-Nobriga[5] and comments from Dan Ray of the Delta Stewardship Council staff. Additional comments on that initial draft were provided by DWR in a September 21 letter to the Delta ISB chair[6]. These discussions and comments helped clarify several issues, particularly on expectations of a WaterFix EIR/EIS.

This final version of the review begins with a summary in the cover letter. The body of the report continues first with a section on our understanding of major differences between the BDCP and California WaterFix. Next, after noting examples of improvement in the Current Draft, we describe our main concerns about the current impact assessments. These overlap with main concerns about the Previous Draft, which we revisit to consider how they are addressed in the Current Draft. Finally, we offer specific comments on several major Sections and Chapters.

DIFFERENCES BETWEEN THE BDCP AND CALIFORNIA WATERFIX

The project proposed in the Current Draft differs in significant respects from what was proposed as the BDCP in December 2013. Here we briefly state our understanding of some main differences and comment on their roles on this review:

- The time period for permitting incidental take under Section 7 of the federal Endangered Species Act (ESA) and Section 2081(b) of the California Endangered Species Act (CESA) is substantially less than the 50 years envisioned as part of a Habitat Conservation Plan (HCP) and Natural Community Conservation Plan (NCCP) in BDCP. As a result, the science associated with many impacts of climate change and sea-level rise may seem less relevant. The permitting period for the project proposed in the Current Draft remains in place unless environmental baseline conditions change substantially or other permit requirements are not met. Consequently, long-term effects of the proposed project remain important in terms of operations and expected benefits (p. 8).

[4] http://deltacouncil.ca.gov/docs/delta-isb-meeting-notice-meeting-notice-delta-isb/delta-independent-science-board-isb-august-13

[5] Written version at https://s3.amazonaws.com/californiawater/pdfs/63qnf_Delta_ISB_draft_statement_-_Enos_-_FINAL.pdf

[6] http://deltacouncil.ca.gov/docs/response-letter-dwr

- In this shortened time frame, responsibility for assessing WaterFix's effects on fish and wildlife would fall to resource agencies (National Marine Fisheries Service, U.S. Fish and Wildlife Service, California Department of Fish and Wildlife). Other impacts would be regulated by a variety of federal and state agencies (Current Draft Section 1).
- The proposed habitat restorations have been scaled back. The Current Draft incorporates elements of 11 Conservation Measures from BDCP to mitigate impacts of construction and operations. Most habitat restoration included in the Previous Draft has been shifted to California EcoRestore. Our review of the Previous Draft contained many comments on the timing of restoration, species interactions, ecological linkages of conservation areas, locations of restoration areas and the science supporting the efficiency and uncertainty of effective restoration. Some of these comments apply less to the Current Draft because of its narrower focus on water conveyance.
- There remains an expected reliance on cooperative science and adaptive management during and after construction.
- It is our understanding that the Current Draft was prepared under rules that disallow scientific methods beyond those used in the Previous Draft. The rules do allow new analyses, however. For example, we noticed evidence of further analyses of contaminants, application of existing methods (e.g. particle tracking) to additional species (e.g., some of the non-covered species), and occasional selection of one model in place of the combined results of two models (e.g., fish life cycle models SALMOD and SacEFT).

IMPROVEMENTS ON THE PREVIOUS DRAFT

A proposed revamping of water conveyance through the Sacramento-San Joaquin Delta involves a multitude of diverse impacts within and outside of the Delta. Unavoidably, the EIR/EIS for such a project will be complex and voluminous, and preparing it becomes a daunting task in its own right. The inherent challenges include highlighting, in a revised EIR/EIS, the most important of the changes.

The new Sections 1 through 4 go a long way toward meeting some of these challenges. Section 1 spells out the regulatory context by discussing laws and agencies that establish the context for the Current Draft. Section 2 summarizes how the Previous Draft was revised in response to project changes and public input. Section 3 describes how the preferred alternative in the Previous Draft (Alternative 4) has been changed. Section 4 presents an impressive amount of detailed information in assessing the sources of habitat loss for various species and discussing how restoration and protection can mitigate those losses. Generally comprehensive lists of "Resource Restoration and Performance Principles" are given for the biological resources that might be affected by construction or operations. For example, page 4.3.8-140 clearly describes a series of measures to be undertaken to minimize the take of sandhill cranes by transmission lines (although the effectiveness of these measures is yet to be determined).

Section 4 also contains improvements on collaborative science (4.1.2.4, mostly reiterated in ES.4.2). This part of the Current Draft draws on recent progress toward collaborative efforts in monitoring and synthesis in support of adaptive management in the Delta. The text identifies the main entities to be involved in an expected memorandum of agreement on a monitoring and adaptive-management program in support of the proposed project.

Appendix A describes revisions to the resource chapters of the Previous Draft. Track-changed versions of the chapters simplify the review process, although this was not done for the

key chapter on aquatic resources (p. 17). We noticed enhanced analyses of contaminants and application of methods such as particle tracking to additional species, including some of the non-covered taxa; a detailed treatment of *Microcystis* blooms and toxicity; more information about disinfection byproducts; improved discussion of vector control arising from construction and operational activities; and revised depiction of surficial geology. Potential exposure of biota to selenium and methylmercury is now considered in greater detail. Evaluations will be conducted for restoration sites on a site-specific basis; if high levels of contaminants cannot otherwise be addressed, alternative restoration sites will be considered (page 4.3.8-118). Incidentally, this is a good example of adaptive management, although it is not highlighted as such. Explanations were provided for why the nitrogen-to-phosphorus ratio was not specifically evaluated, why dissolved vs. total phosphorus was used in the assessment, and how upgrades to the Sacramento Regional Wastewater Treatment Plant would eventually affect phosphorus concentrations.

CURRENT CONCERNS

These and other strengths of the Current Draft are outweighed by several overarching weaknesses: overall incompleteness through deferral of content to the Final EIR/EIS (herein, "the Final Report"); specific incompleteness in treatment of adaptive management, habitat restoration, levees, and long-term effects; and inadequacies in presentation. Some of these concerns overlap with ones we raised in reviewing the Previous Draft (revisited below, beginning on p. 10).

Missing content

The Current Draft lacks key information, analyses, summaries, and comparisons. The missing content is needed for evaluation of the science that underpins the proposed project. Accordingly, the Current Draft fails to adequately inform weighty decisions about public policy. The missing content includes:

1. Details on adaptive management and collaborative science (below, p. 5).
2. Modeling how levee failures would affect operation of dual-conveyance systems (below, p. 7). Steve Centerwall told us on August 14 that modeling of the effects of levee failure would be presented in the Final Report.
3. Analysis of whether operation of the proposed conveyance would alter the economics of levee maintenance (below, p. 7).
4. Analyses of the effects of climate change on expected water exports from the Delta. "[A]n explanation and analysis describing potential scenarios for future SWP/CVP system operations and uncertainties [related to climate change] will be provided in the Final Report" (p. 1-35 of the Current Draft).
5. Potential impacts of climate change on system operations, even during the shortened time period emphasized in the Current Draft (below, p. 8 and 11).
6. Potential effects of changes in operations of the State Water Project (SWP) and Central Valley Project (CVP), or other changes in water availability, on agricultural practices in the San Joaquin Valley (p. 12).
7. Concise summaries integrated with informative graphics (below, p. 9 and 13). The Current Draft states that comparisons of alternatives will be summarized in the Final Report (p. 1-35).

While some of the missing content has been deferred to the Final Report (examples 2, 4, and 7), other gaps have been rationalized by deeming impacts "too speculative" for assessment.

CEQA guidance directs agencies to avoid speculation in preparing an EIR/EIS[7] . To speculate, however, is to have so little knowledge that a finding must be based on conjecture or guesswork. Ignorance to this degree does not apply to potential impacts of WaterFix on levee maintenance (example 3; see p. 7) or on San Joaquin Valley agriculture (example 6; p. 12).

Even if content now lacking would go beyond what is legally required for an EIR/EIS, providing such content could assist scientists, decision-makers, and the public in evaluating California WaterFix and Delta problems of statewide importance (above, p. 1).

Adaptive management

The guidelines for an EIR/EIS do not specifically call for an adaptive-management plan (or even for adaptive management). However, if the project is to be consistent with the Delta Plan (as legally mandated), adaptive management should be part of the design.

The Current Draft relies on adaptive management to address uncertainties in the proposed project, especially in relation to water operations. The development of the Current Draft from the Previous Draft is itself an exercise in adaptive management, using new information to revise a project during the planning stage. Yet adaptive management continues to be considered largely in terms of how it is to be organized (i.e., coordinated with other existing or proposed adaptive-management collaborations) rather than how it is to be done (i.e., the process of adaptive management). Adaptive management should be integral with planned actions and management—the Plan A rather than a Plan B to be added later if conditions warrant. The lack of a substantive treatment of adaptive management in the Current Draft indicates that it is not considered a high priority or the proposers have been unable to develop a substantive idea of how adaptive management would work for the project.

There is a very general and brief mention of the steps in the adaptive management process in Section 4 (p. 4.1-6 to 4.1-7), but nothing more about the process. We were not looking here for a primer on adaptive management. Rather, we expected to find serious consideration of barriers and constraints that have impeded implementation of adaptive management in the Delta and elsewhere (which are detailed in the Delta Plan), along with lessons learned on how adaptive management can be conducted overcome these problems.

The Current Draft contains general statements on how collaborative science and adaptive management under California WaterFix would be linked with the Delta Collaborative Science and Adaptive Management Program (CSAMP) and the Collaborative Adaptive Management Team (CAMT). These efforts, however, have taken place in the context of regulations and permits, such as biological opinions and biological assessments required under the Endangered Species Act. We did not find examples of how adaptive management would be applied to assessing—and finding ways to reduce—the environmental impacts of project construction and operations.

Project construction, mitigation, and operations provide many opportunities for adaptive management, both for the benefit of the project as well as for other Delta habitat and ecosystem initiatives, such as EcoRestore. To be effective in addressing unexpected outcomes and the need for mid-course corrections, an adaptive-management management team should evaluate a broad range of actions and their consequences from the beginning, as plans are being developed, to facilitate the early implementation and effectiveness of mitigation activities.

[7] https://s3.amazonaws.com/californiawater/pdfs/bo0lx_Delta_ISB_Draft_Statement_&_Response_Letter_-_Enos_-_FINAL.pdf

The Current Draft defers details on how adaptive management will be made to work: "An adaptive management and monitoring program will be implemented to develop additional scientific information during the course of project construction and operations to inform and improve conveyance facility operational limits and criteria" (p. ES-17). This is too late. If adaptive management and monitoring are central to California WaterFix, then details of how they will be done and resourced should be developed at the outset (now) so they can be better reviewed, improved, and integrated into related Delta activities. The details could include setting species-specific thresholds and timelines for action, creating a Delta Adaptive Management Team, and capitalizing on unplanned experiments such as the current drought[8]. Illustrative examples could use specific scenarios with target thresholds, decision points, and alternatives. The missing details also include commitments and funding needed for science-based adaptive management and restoration to be developed and, more importantly, to be effective.

The protracted development of the BDCP and its successors has provided ample time for an adaptive-management plan to be fleshed out. The Current Draft does little more than promise that collaborations will occur and that adaptive management will be implemented. This level of assurance contrasts with the central role of adaptive management in the Delta Plan and with the need to manage adaptively as climate continues to change and new contingencies arise.

Restoration as mitigation

Restoration projects should not be planned and implemented as single, stand-alone projects but must be considered in a broader, landscape context. We highlighted the landscape scale in our review of the Previous Draft and also in an earlier review of habitat restoration in the Delta[9]. A landscape approach applies not just to projects that are part of EcoRestore, but also to projects envisioned as mitigation in the Current Draft, even though the amount of habitat restoration included (as mitigation) in the Current Draft has been greatly reduced. On August 13 and 14, representatives of WaterFix and EcoRestore acknowledged the importance of the landscape scale, but the Current Draft gives it little attention. Simply because the CEQA and NEPA guidelines do not specifically call for landscape-level analyses is not a sufficient reason to ignore them.

Wetland restoration is presented as a key element of mitigation of significant impacts (example below in comments on Chapter 12, which begin on p. 18). We noticed little attention to the sequence required for assessing potential impacts to wetlands: first, avoid wetland loss; second, if wetland loss cannot be avoided, minimize losses; and third, if avoidance or minimization of wetland loss is not feasible, compensate. Much of the emphasis in the Current Draft is on the third element. Sequencing apparently will be addressed as part of the permitting process with the US Army Corps of Engineers (USACE) for mitigation related to the discharge of dredged or fill material.[10] However, it is difficult to evaluate the impacts on wetlands in advance of a clarification of sequencing and criteria for feasibility.

Mitigation ratios

Restoring a former wetland or a highly degraded wetland is preferable to creating wetlands from uplands[11]. When an existing wetland is restored, however, there is no net gain of

[8] http://deltacouncil.ca.gov/docs/adaptive-management-report-v-8
[9] http://deltacouncil.ca.gov/sites/default/files/documents/files/HABITAT%20RESTORATION%20REVIEW%20FINAL.pdf
[10] Letter from Cassandra Enos-Nobriga, DWR, September 21, 2015.
[11] http://www.nap.edu/openbook.php?isbn=0309074320

area, so it is unclear whether credits for improving existing wetlands would be considered equivalent to creating wetlands where they did not recently exist.

In view of inevitable shortcomings and time delays in wetland restorations, mitigation ratios should exceed 1:1 for enhancement of existing wetlands. The ratios should be presented, rather than making vague commitments such as "restore or create 37 acres of tidal wetland…." The Final Draft also needs to clarify how much of the wetland restoration is out-of-kind and how much is in-kind replacement of losses. It should examine whether enough tidal area exists of similar tidal amplitude for in-kind replacement of tidal wetlands, and whether such areas will exist with future sea-level rise. We agree that out-of-kind mitigation can be preferable to in-kind when the trade-offs are known and quantified and mitigation is conducted within a watershed context, as described in USACE's 2010 guidance for compensatory wetland mitigation.[12] Since then, many science-based approaches have been developed to aid decision-making at watershed scales, including the 2014 Watershed Approach Handbook produced by the Environmental Law Institute and The Nature Conservancy[13].

Restoration timing and funding

To reduce uncertainty about outcomes, allow for beneficial and economical adaptive management, and allow investigators to clarify benefits before the full impacts occur, mitigation actions should be initiated as early as possible. Mitigation banks are mentioned, but are any operational or planned for operation soon? The potential for landowners to develop mitigation banks could be encouraged so restoration could begin immediately, engendering better use of local knowledge, financial profit, and local support for the project. We are told that the timing of mitigation will be coordinated with other review processes that are currently ongoing.[6]

Levees

A comprehensive assessment of environmental impacts should relate California WaterFix to levee failure by examining the consequences each may have for the other. The interplay between conveyance and levees is receiving additional attention through the Delta Levee Investment Strategy.

On the one hand, the Current Draft fails to consider how levee failures would affect the short-term and long-term water operations spelled out in Table 4.1-2. A rough estimate was proposed under the Delta Risk Management Study[14] and another is part of a cost-benefit analysis for the BDCP[15]. The Final Report should provide analyses that incorporate these estimates.

On the other hand, the Current Draft also fails to consider how implementing the project would affect the basis for setting the State's priorities in supporting Delta levee maintenance. This potential impact is illustrated by a recent scoring system of levee-project proposals that awards points for expected benefits to "export water supply reliability"[16]. Further efforts to quantify these benefits have been recommended as part of a comprehensive risk assessment that

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[12] http://www.sac.usace.army.mil/Portals/43/docs/regulatory/Guidelines_for_Preparing_a_Compensatory_Mitigation_Planf.pdf

[13] https://www.eli.org/sites/default/files/eli-pubs/watershed-approach-handbook-improving-outcomes-and-increasing-benefits-associated-wetland-and-stream_0.pdf

[14] http://www.water.ca.gov/floodmgmt/dsmo/sab/drmsp/docs/Delta_Seismic_Risk_Report.pdf

[15] http://baydeltaconservationplan.com/Libraries/Dynamic_Document_Library/Draft_BDCP_Statewide_Economic_Impact_Report_8513.sflb.ashx

[16] http://www.water.ca.gov/floodsafe/fessro/docs/special_PSP14_final.pdf

would guide the Delta Levees Investment Strategy[17]. Public safety, a focus of the Delta Flood Emergency Management Plan,[18] is just one asset that levees protect. The Current Draft does not evaluate how the proposed project may affect estimates of the assets that the levees protect.

The Current Draft cites levee fragility mainly as a reason to build isolated conveyance for Sacramento River water (examples, p. 1-1, 1-7, 1-9). In a similar vein, the California WaterFix website states, "Aging dirt levees are all that protect most of California's water supplies from the affects [*sic*] of climate change. Rising sea levels, intense storms, and floods could all cause these levees to fail, which would contaminate our fresh water with salt, and disrupt water service to 25 million Californians"[19]. Neither the Previous Draft nor the Current Draft, however, provides a resource chapter about Delta levees. Such a chapter would be an excellent place to examine interacting impacts of conveyance and levees.

Long-term effects

With the shortened time period, several potential long-term impacts of or on the proposed project no longer receive attention. While these effects may not become problematic during the initial permit period, many are likely to affect project operations and their capacity to deliver benefits over the long operational life of the proposed conveyance facilities. In our view, consideration of these long-term effects should be part of the evaluation of the science foundation of the proposed project.

The No-Action alternative establishes the baseline for evaluating impacts and benefits of the proposed alternative(s). It is therefore important to consider carefully how the baseline is established, as this can determine whether particular consequences of the alternatives have costs or benefits. Climate change, for example, is considered under the No-Action alternative in the Current Draft, as is sea-level rise. Climate change is expected to reduce water availability for the proposed northern intakes, and both climate change and sea-level rise are expected to influence tidal energy and salinity intrusion within the Delta[20]. Changes in water temperature may influence the condition of fishes that are highly temperature-dependent in the current analyses. These environmental effects, in turn, are likely to influence environmental management and regulation; from the standpoint of water quality they may even yield environmental benefits if agricultural acreage decreases and agricultural impacts are reduced.

Rather than consider such effects, however, the Current Draft focuses on how the proposed project would affect "the Delta's resiliency and adaptability to expected climate change" (Current Draft section 4.3.25). Quite apart from the fact that "resiliency" and "adaptability" are scarcely operational terms, the failure to consider how climate change and sea-level rise could affect the outcomes of the proposed project is a concern that carries over from our 2014 review and is accentuated by the current drought (below, p. 11).

The Current Draft states that "Groundwater resources are not anticipated to be substantially affected in the Delta Region under the No Action Alternative (ELT) because surface water inflows to this area are sufficient to satisfy most of the agricultural, industrial, and municipal water supply needs" (p. 4.2-16). This conclusion is built on questionable assumptions; the current drought illustrates how agriculture turns to groundwater when surface-water availability diminishes. Groundwater regulation under the recently enacted Sustainable

[17] http://deltacouncil.ca.gov/docs/delta-levee-investment-strategy/dlis-peer-review-technical-memorandum-31
[18] http://www.water.ca.gov/floodmgmt/hafoo/fob/dreprrp/InterdepartmentalDraftDFEMP-2014.pdf.
[19] http://www.californiawaterfix.com/problem
[20] http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0024465

Groundwater Management Act (SGMA) can also be expected to have long-term effects on the proposed project—effects that the Current Draft does not assess. Ending of more than a million acre-feet of overdraft in the southern Central Valley under the SGMA is likely to increase demand for water exports from the Delta in the coming decades. The Current Draft discusses the potential effects of the project on groundwater (for example, in Sections 4.3.3 and 5.2.2.3), but we found only two brief, descriptive mentions of SGMA in the 235 pages of Section 5. The implications of prolonged droughts (e.g., on levee integrity) and of the consequences of SGMA receive too little attention in the Current Draft.

The Current Draft suggests that unnamed "other programs" that are "separate from the proposed project" will use elements of the Previous Draft to implement long-term conservation efforts that are not part of California WaterFix (Current Draft, p. 1-3). The Final Report should provide assurances that such other programs will step in, and could go further in considering their long-term prospects.

Informative summaries and comparisons

According to guidance for project proponents, "Environmental impact statements shall be written in plain language and may use appropriate graphics so that decision-makers and the public can readily understand them" (Code of Federal Regulations, 40 CFR 1502.8). Far-reaching decisions should not hinge on environmental documents that few can grasp.

This guidance applies all the more to an EIR/EIS of the scope, complexity, and importance of the Current Draft. It demands excellent comparative descriptions of alternatives that are supported by readable tables and high-quality graphics, enumeration of major points, well-organized appendices, and integration of main figures with the text. For policy deliberations, the presentation of alternatives should include explicit comparisons of water supply deliveries and reliabilities as well as economic performance. For decision-makers, scientists, and the public, summaries of impacts should state underlying assumptions clearly and highlight major uncertainties. The Current Draft is inadequate in these regards.

The Previous Draft provided text-only summaries for just the two longest of its resource chapters (Chapters 11 and 12). A fragmentary comparison of alternatives was buried in a chapter on "Other CEQA/NEPA required sections" (part 3 of Chapter 31) but fell far short of what was needed. Both the Previous and Current Drafts have been accompanied by a variety of outreach products for broad audiences (e.g., the descriptive overview of the BDCP Draft EIR/EIS[21]). These products do little to compensate for the overall paucity of readable summaries and comparisons in the Previous and Current Drafts.

For over three years, the Delta ISB has been specifically requesting summaries and comparisons: first in June 2012[22], then in June 2013[23], and again in a review of the Previous Draft in May 2014 (footnote 1, p. 1). Appallingly, such summaries and comparisons remain absent in the Current Draft. The generally clear writing in Sections 1 through 4 shows that the preparers are capable of providing the requested summaries and comparisons. Prescriptions in CEQA and NEPA in no way exclude cogent summaries, clear comparisons, or informative graphics. And three years is more than enough time to have developed them.

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[21] Highlights+of+the+Draft+EIS-EIR+12-9-13.pdf

[22] http://deltacouncil.ca.gov/sites/default/files/documents/files/DISB_Letter_to_JMeral_and_DHoffman-Floerke_061212.pdf

[23] http://deltacouncil.ca.gov/sites/default/files/documents/files /DISB%20Comments%20on%20Draft%20BDCP%20Document.doc_.pdf

On August 14, 2015, representatives of California WaterFix assured us that this kind of content would eventually appear, but only in the Final Report. That will be far too late in the EIR/EIS process for content so critical to comprehending what is being proposed and its potential impacts.

PRIOR CONCERNS AND THEIR RELEVANCE TO THE CURRENT DRAFT

The Delta ISB review of May 14, 2014 emphasized eight broad areas of concern about the scientific basis for the Previous Draft. Each is summarized below, followed by a brief appraisal of how (or whether) the concern has been dealt with in the Current Draft. While the reduced scope of the proposed project has reduced the relevance of some issues, particularly habitat restoration and other conservation measures, other concerns persist.

Our persistent concerns include the treatment of uncertainty, the implementation of adaptive management, and the use of risk analysis. These topics receive little or no further attention in the Current Draft. We also found few revisions in response to points we raised previously about linkages among species, ecosystem components, or landscapes; the potential effects of climate change and sea-level rise; and the potential effects of changes in water availability on agricultural practices and the consequent effects on the Delta. Our previous comments about presentation also pertain.

Effectiveness of conservation actions

Our 2014 review found that many of the impact assessments hinged on optimistic expectations about the feasibility, effectiveness, or timing of the proposed conservation actions, especially habitat restoration.

This is arguably less of a concern now, given the substantially shorter time frame of the revised project and narrower range of conservation actions designed for compensatory restoration. Nonetheless, the Current Draft retains unwarranted optimism, as on page 4.3.25-10: "By reducing stressors on the Delta ecosystem through predator control at the north Delta intakes and Clifton Court Forebay and installation of a nonphysical fish barrier at Georgiana Slough, Alternative 4A will contribute to the health of the ecosystem and of individual species populations making them stronger and more resilient to the potential variability and extremes caused by climate change." A scientific basis for this statement is lacking, and an adaptive or risk-based management framework is not offered for the likely event that such optimism is unfulfilled.

Is it feasible for even the reduced amounts of mitigation and restoration to be completed within the time period proposed? Perhaps yes. Is it feasible that these actions will mitigate impacts over the long term? This is more problematic. To be effective, mitigation actions should deal with both the immediate and long-term consequences of the project. The proposed permitting should allow for monitoring long enough to assess the effectiveness of habitat restoration measures, which will need to extend beyond the initial permitting period.

Uncertainty

The 2014 review found the BDCP encumbered by uncertainties that were considered inconsistently and incompletely. We commented previously that modeling was not used effectively enough in bracketing uncertainties or exploring how they may propagate or be addressed.

In the Current Draft, uncertainties and their consequences remain inadequately addressed, improvements notwithstanding. Uncertainties will now be dealt with by establishing "a robust program of collaborative science, monitoring, and adaptive management" (ES 4.2). No details about this program are provided, so there is no way to assess how (or whether) uncertainties will be dealt with effectively. Although sensitivity modeling was used to address the effects of changes in the footprint and other minor changes of the revised project, full model runs were not carried out to assess the overall effects of the specific changes. Consequently, modeling that would help to bracket ranges of uncertainties or (more importantly) assess propagation of uncertainties is still inadequate.

Many of our prior concerns about uncertainties pertained to impacts on fish. If those uncertainties have now been addressed in Chapter 11, they are difficult to evaluate because changes to that chapter have not been tracked in the public draft (below, p. 17).

There are also uncertainties with the data generated from model outputs, although values are often presented with no accompanying error estimates. This situation could be improved by presenting results from an ensemble of models and comparing the outputs.

Effects of climate change and sea-level rise on the proposed actions

Our 2014 review stated concerns that the Previous Draft underestimated effects of climate change and sea-level rise across the 50-year timeline of the BDCP. With the nominal duration shortened substantially, most of the projected impacts of climate change and sea-level rise may occur later. But climate-related issues remain.

First, the Current Draft is probably outdated in its information on climate change and sea-level rise. It relies on information used in modeling climate change and sea-level rise in the Previous Draft, in which the modeling was conducted several years before December 2013. The absence of the climate-change chapter (Chapter 29) in the Previous Draft from Appendix A in the Current Draft indicates that no changes were made. In fact, the approaches and assumptions in the Current Draft remained unchanged from the Previous Draft in order to ensure consistency and comparability across all the Alternatives, even though newer scientific information had become available.[6] Yet climatic extremes, in particular, are a topic of intense scientific study, illustrated by computer simulations of ecological futures[24] and findings about unprecedented drought[25]. The Current Draft does not demonstrate consideration of recently available climate science, and it defers to the Final Report analysis of future system operations under potential climate and sea-level conditions. In fact, the Current Draft generally neglects recent literature, suggesting a loose interpretation of "best available science."

Second, climate change and sea-level rise are now included in the No-Action Alternative, as they will transpire whether or not WaterFix moves forward. A changed future thus becomes the baseline against which Alternative 4A (and the others) are compared. Changes in outflow from the Delta due to seasonal effects of climate change and the need to meet fall X2 requirements are considered in Section 4.3.1. The difference in outcomes then depends on assumptions about the facility and operations of Alternative 4A and the other Alternatives. Sensitivity analyses indicate that the impacts of the different Alternatives are generally similar in comparison to the No Action Alternative under the range of climate projections considered.[6] Thus, "Delta exports would either remain similar or increase in wetter years and remain similar

[24] http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0024465

[25] Cook, B.I., Ault, T.R., and Smerdon, J.E., 2015, Unprecedented 21st century drought risk in the American Southwest and Central Plains: *Science Advances*, v. 1, doi:10.1126/sciadv.1400082.

or decrease in the drier years under Alternative 4A as compared to the conditions without the project." (p. 4.3.1-4). Such an inconclusive conclusion reinforces the need to be able to adapt to different outcomes. Simply because the Alternatives are expected to relate similarly to a No Action Alternative that includes climate change does not mean that the Alternatives will be unaffected by climate change.

Interactions among species, landscapes, and the proposed actions

The Previous Draft acknowledged the complexities produced by webs of interactions, but it focused on individual species, particular places, or specific actions that were considered in isolation from other species, places, or actions. Potential predator-prey interactions and competition among covered and non-covered fish species were not fully recognized. Confounding interactions that may enhance or undermine the effectiveness of proposed actions were overlooked. In our 2014 review we recommended describing and evaluating the potential consequences of such interactions, particularly in Chapters 11 (Fish and aquatic resources) and 12 (Terrestrial resources).

The Current Draft recognizes that mitigation measures for one species or community type may have negative impacts on other species or communities, and mitigation plans may be adjusted accordingly. But the trade-offs do not seem to be analyzed or synthesized. This emphasizes the need for a broader landscape or ecosystem approach that comprehensively integrates these conflicting effects.

Effects on San Francisco Bay, levees, and south-of-Delta environments

In 2014 we pointed to three kinds of impacts that the Previous Draft overlooked: (1) effects on San Pablo Bay and San Francisco Bay in relation to Delta tides, salinity, and migratory fish; (2) effects of levee failures on the proposed BDCP actions and effects of isolated conveyance on incentives for levee investments; and (3) effects of increased water reliability on crops planted, fertilizers and pesticides used, and the quality of agricultural runoff. The Current Draft responds in part to point 1 (in 11.3.2.7) while neglecting point 2 (above, p. 7) and point 3.

On point 3: Although the Current Draft considers how the project might affect groundwater levels south of the Delta (7.14 to 7.18), it continues to neglect the environmental effects of water use south of (or within) the Delta. Section 4.3.26.4 describes how increased water-supply reliability could lead to increased agricultural production, especially during dry years. Elsewhere, a benefit-cost analysis performed by ICF and the Battle Group[26] calculated the economic benefits of increased water deliveries to agriculture in the Delta. The Current Draft does not fully consider the consequences of these assumptions, or of the projections that the project may enhance water-supply reliability but may or may not increase water deliveries to agriculture (depending on a host of factors). We have been told that to consider such possibilities would be "too speculative" and that such speculations are explicitly discouraged in an EIR/EIS. Yet such consequences bear directly on the feasibility and effectiveness of the project, and sufficient information is available to bracket a range of potential effects. Our previous concerns are undiminished.

The impacts of water deliveries south of the Delta extend to the question of how each intake capacity (3,000, 9,000, or 15,000 cfs) may affect population growth in Southern

[26] Hecht, J., and Sunding, D., Draft Bay Delta Conservation Plan statewide economic impact report, August 2013.

California. Section 4.4.1-9 treats the growth-enabling effects of alternative 2D lightly, saying that additional EIS review would be needed for future developments.

Implementing adaptive management

In the Previous Draft, details about adaptive management were to be left to a future management team. In our 2014 review we asked about situations where adaptive management may be inappropriate or impossible to use, contingency plans in case things do not work as planned, and specific thresholds for action.

Although most ecological restoration actions have been shifted to California EcoRestore (p. 5), we retain these and other concerns about adaptive management under California WaterFix. If the mitigation measures for terrestrial resources are implemented as described, for example, they should compensate for habitat losses and disturbance effects of the project. The test will be whether the measures will be undertaken as planned, be as effective as hoped, and continue long enough to fully mitigate effects. This is where adaptive management and having contingency plans in place becomes critically important. It is not apparent that the mitigation plans include these components.

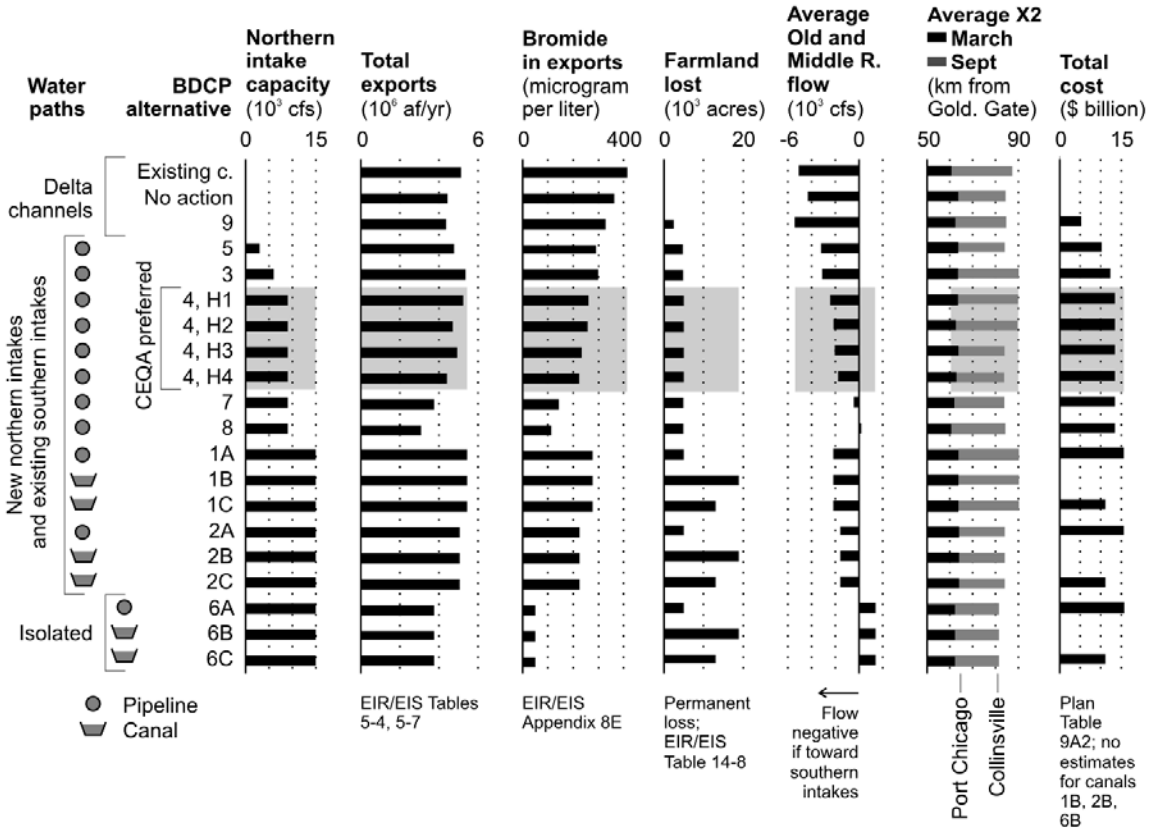
Reducing and managing risk

Our 2014 review advised using risk assessment and decision theory in evaluating the proposed BDCP actions and in preparing contingency plans. We noticed little improvement on this issue, just a mention that it might be considered later. This is not how the process should be used.

Comparing BDCP alternatives

The Previous Draft contained few examples of concise text and supporting graphics that compare alternatives and evaluate critical underlying assumptions. Rudimentary comparisons of alternatives were almost entirely absent. The Current Draft retains this fundamental inadequacy (p. 9).

Our 2014 review urged development and integration of graphics that offer informative summaries at a glance. We offered the example reproduced below. If the Current Draft contains such graphics, they would need to be ferreted out from long lists of individual pdf files. Because they are not integrated into the text where they are referenced in the Current Draft, the figures cannot readily illustrate key points.



COMMENTS ON INDIVIDUAL SECTIONS AND CHAPTERS

This final section of the review contains minimally edited comments on specific points or concerns. These comments are organized by Section or Chapter in the Current Draft. Many are indexed to pages in the section or chapter named in the heading.

Alternatives 4A, 2D, and 5A (Section 4)

It is good that the proposed alternatives are seen as flexible proposals, as it is difficult to imagine that any proposal for such a complex and evolving system could be implemented precisely as proposed. Some initial and ongoing modifications seem desirable, and unavoidable.

The operating guidance for the new alternatives seems isolated from the many other water management and environmental activities in and upstream of the Delta likely to be important for managing environmental and water supply resources related to Delta diversions. While it is difficult to specify detailed operations for such a complex system, more details on the governance of operations (such as the Real Time Operations process) would be useful. The operational details offered seem to have unrealistic and inflexible specificity. Presentations of delivery-reliability for different alternatives remain absent. Environmental regulations on Delta diversions have tended to change significantly and abruptly in recent decades, and seem likely to change in the future. How sensitive are project water supply and environmental performance to changes in operating criteria?

The collaborative science ideas seem philosophically attractive, but are not given much substance. Monitoring is mentioned, but details of organization, intent, and resources seem

lacking. Adequate funding to support monitoring, collaborative science, and adaptive management is a chronic problem. Section ES.4.2 states that "Proponents of the collaborative science and monitoring program will agree to provide or seek additional funding when existing resources are insufficient." This suggests that these activities are lower in priority than they should be.

The three new alternatives, 4A, 2D, and 5A, seem to have modest changes over some previous alternatives, with the exception of not being accompanied by a more comprehensive environmental program. In terms of diversion capacities, they cover a wide range, 3,000 cfs (5A), 9,000 cfs (4A), and 15,000 cfs (2D). The tables comparing descriptions of the new alternatives to previous Alternative 4 are useful, but should be supplemented by a direct comparison of the three new alternatives.

The new Sustainable Groundwater Management Act (SGMA) seems likely to increase demands for water diversions from the Delta to the south to partially compensate for the roughly 1.5-2 maf/year that is currently supplied by groundwater overdraft.

The State seems embarked on a long-term reduction in urban water use, particularly outdoor irrigation. Such a reduction in urban water use is likely to have some modest effects on many of the water-demand and scarcity impacts discussed.

The climate change analysis of changes in Delta inflows and outflows is useful, but isolating the graphs in a separate document disembodies the discussion. The fragmentation of the document by removing each Section 4 figure into a separate file is inconvenient for all, and makes integrated reading practically impossible for many.

The details of the alternative analyses seem mostly relevant and potentially useful. Much can be learned about the system and the general magnitude of likely future outcomes from patient and prolonged reading of this text. An important idea that emerges from a reading of the No Action Alternative is that the Delta, and California water management, is likely to change in many ways with or without the proposed project. The No Action and other alternatives also illustrate the significant inter-connectedness of California's water system. The range of impacts considered is impressive, but poorly organized and summarized.

The discussion of disinfection by-product precursor effects in Delta waters is improved significantly, but could be made more quantitative in terms of economic and public-health impacts.

The discussion on electromagnetic fields is suitably brief, while the tsunami discussion could be condensed.

The effects of the likely listing of additional native fish species as threatened or endangered seems likely to have major effects on project and alternative performance. These seem prudent to discuss, and perhaps analyze.

Is Alternative 2D, with 15,000 cfs capacity, a serious alternative? Does it deserve any space at all?

Table 4.1-8 implies that tidal brackish/*Schoenoplectus* marsh. Should some of this be considered tidal freshwater marsh?

The dynamics of the Delta are largely determined by water flows. The Current Draft acknowledges that water flows and salinity will change in complex ways. There are statements about how inflows, outflows, and exports will change in Alternative 4A in relation to baseline (No-Action) conditions (p. 4.3.8-13). What is the scientific basis on which these changes will be managed? Will models be used? What confidence should we have in current projections? Have the effects of droughts or deluges been considered?

4.3.7-10, line 13: Text on disturbing sediments and releasing contaminants needs to add nitrogen and phosphorus to the concerns.

Water quality (Chapter 8)

8-3, line 13: *Microcystis* is singled out as a cyanobacterium that can (but doesn't always) produce the toxin, myrocystin; however, there are other cyanobacteria that sometimes produce other toxins. Different genera can differ in the nutrient that limits their blooms (see 2014 letter by Hans Paerl in Science 346(6406): 175-176). For example, *Microcystis* blooms can be triggered by N additions because this species lacks heterocysts, while toxin-producing *Anabaena* blooms can be triggered by P additions, because *Anabaena* has heterocysts and can fix N. The frequently repeated discussion of cyanobacteria blooms needs to be updated. Also cite Paerl on page 8-45 line 8. Ditto on page 8-103 and 8-106 line 34.

8-8. In our earlier comments, we recommended that carbon be separated into its dissolved and particulate forms for consideration of water quality impacts because dissolved organic carbon (DOC) is the form most likely to react with chloride and bromide and result in formation of disinfection by-products. The section on bromide focuses on interactions with total organic carbon (TOC), rather than DOC. Carbon is primarily considered with respect to formation of disinfection by-products but carbon plays a central role in the dynamics of the Delta, affecting processes such as metabolism, acidity, nutrient uptake, and bioavailability of toxic compounds. Carbon cycling determines ecosystem structure and function in aquatic systems. It also modifies the influence and consequences of other chemicals and processes in aquatic systems. Dissolved organic carbon (DOC), for example, influences light and temperature regimes by absorbing solar radiation, affects transport and bioavailability of metals, and controls pH in some freshwater systems. Respiration of organic carbon influences dissolved oxygen concentrations and pH.

8-18, line 12 says that salt disposal sites were to be added in 2014; were they?

8-19 and 8-20: "CECs" is not defined and seems to be used incorrectly. Change "CECs" to "EDCs" on page 8-19 and to "PPCPs" on page 8-20.

8-21, line 18-19: Such a statement should be qualified. The conclusion that marine waters are N-limited and inland waters are P-limited is outdated. Recent papers, including the above, find more complex patterns.

8-22, lines 18 and 30: Choose either "cyanobacteria" or "blue-green algae;" using both will confuse readers who may perceive them as different.

8-23, lines 15-16: Say how the N:P ratio changed composition, not just that it did change composition.

8-23 through 8-25: Uncertainties (e.g., standard deviation or standard error of the mean) associated with the mean concentrations of DOC should be presented. It is impossible to interpret differences between the values that are presented without knowledge of the variation around the mean values (e.g., without knowledge of variation around the mean, it is difficult to evaluate whether DOC concentrations at south vs. north-of-Delta stations and Banks headworks differ from one another; 3.9 to 4.2 mg/L vs. 4.3 mg/L).

8-65, line 12: Specify if DO is for daytime or night, and for surface, bottom or mid-water column.

8-75, line 6: The failure to consider dissolved P (DP) should be addressed; there is much greater uncertainty. The adherence of some P to sediment does not prevent considerable

discharge of P as DP. Also on page 8-95 line 40, qualify predictions due to lack of consideration of DP.

8-82, line 4-5: It seems unlikely that current levels of *Microcystis* growth in the Delta are dependent on the exclusive uptake of ammonia. Temperature is one of the primary factors driving *Microcystis* blooms and global warming could promote bloom occurrence. Consider revising this section to, "Because it seems unlikely that current levels of *Microcystis* growth in the Delta are dependent on the exclusive uptake of ammonia, the frequency, magnitude and geographic extent of *Microcystis* under future scenarios is difficult to predict."

8-105, line 8: Would total nitrogen be dominated by nitrate just by increasing ammonia removal? Depending on redox and microbiota, why wouldn't nitrate be converted to ammonium?

A lot of attention is given to factors controlling *Microcystis* blooms in this chapter but little attention is given to its toxicity. Just as factors controlling blooms are not fully understood, the regulating factors of cellular toxin contents remain poorly understood. As a result, the impact of blooms on the environment can vary (e.g., large blooms of non-toxic or low toxin organisms may have impacts on environmental variables such as nutrient uptake and dissolved oxygen consumption while small blooms of highly toxic organisms could impact food webs) [see: Ma et al. (2015) Toxic and non-toxic strains of *Microcystis aeruginosa* induce temperature dependent allelopathy toward growth and photosynthesis of *Chlorella vulgaris*. Harmful Algae 48: 21–29].

Fish and aquatic resources (Chapter 11)

We found individual conclusions or new analyses difficult to identify in this key chapter because changes to it were not tracked in the public version of the Current Draft and there was no table of contents that could have assisted in side-by-side comparison with the Previous Draft.

Effects of temperature

We noticed more emphasis on temperature concerning the fish 'downstream' impacts (but without tracked changes this becomes difficult to document).

The main temperature variable used expresses the percentage of time when monthly mean temperatures exceed a certain rate or fall within a certain boundary. The biological impact, however, is difficult to assess with these numbers. If all of the change occurred just during operations or just during one day, the biological impact could be much different than a small change every day (provided by using means). Graphs of changes and listing of extreme highs and lows during a model run would have more biological meaning. Also, comparisons were made using current baseline conditions and did not consider climate change effects on temperatures.

Fish screens

It is unclear how (and how well) the fish screens would work. The description of fish screens indicates that fish >20 mm are excluded, but what about fish and larvae that are <20 mm, as well as eggs? Table 11-21 seems out of date, because some fish screens appear to have been installed, but data on their effects are not given. Despite the lack of specific data on how well screens function, the conclusion that there will be no significant impact is stated as certain (e.g., page 1-100 line 38).

Here, as in many other places, measures are assumed to function as planned, with no evidence to support the assumptions. The level of certainty seems optimistic, and it is unclear whether there are any contingency plans in case things don't work out as planned. This problem persists from the Previous Draft.

Invasive plants

Cleaning equipment is mentioned, but it is not specifically stated that large machinery must be cleaned before entering the Delta. Section 4.3.8-358 says equipment would be cleaned if being moved within the Delta. Cleaning is essential to reduce transfer of invasive species; a mitigating measure is to wash equipment, but it must also be enforced.

Weed control (fire, grazing) is suggested, but over what time frame? It may be needed in perpetuity. That has been our experience at what is considered the world's oldest restored prairie (the 80-yr-old Curtis Prairie, in Madison, WI).

Weed invasions can occur after construction is completed; how long will the project be responsible for weed control? 3-5 years won't suffice.

4.3.8-347. Herbicides are prescribed to keep shorebird nesting habitat free of vegetation, but toxic effects of herbicides on amphibians etc. are not considered.

4.3.8-354. Impacts of invasive plants seem underestimated. Impact analysis implies that the project disturbance area is the only concern, when dispersal into all areas will also be exacerbated. At the Arboretum, a 1200-ac area dedicated to restoration of pre-settlement vegetation, invasive plants are the main constraint. A judgment of no significant impact over just the disturbance area is overly optimistic.

4.3.8-356. Does not mention need to clean equipment to minimize import of seeds on construction equipment.

Cryptic acronym and missing unit

Figure 2: SLR x year: y axis lacks units; reader has to continue on to table 11-20 to find that it is cm.

Terrestrial biological resources (Chapter 12)

Effects on wetlands and waters of the United States (WOTUS)

Page 12-1, line 18-19 says: "Under Alternatives 2D, 4 , 4A , and 5A, larger areas of non-wetland waters of the United States would be filled due to work in Clifton Court Forebay; however, the Forebay would ultimately expand by 450 acres and thus largely offset any losses there." Is the assumption that, acre for acre, all jurisdictional waters are interchangeable, whether of different type or existing vs. created? The literature does not support this assumption.

The text argues that the wetlands would be at risk with levee deterioration, sea-level rise, seismic activity, etc. But the solution is for "other programs" to increase wetlands and riparian communities. What if this project causes the problem, e.g. via vibration?

CM1 alternative 4A would fill 775 acres of WOTUS (491 wetland acres); Alt 2D would fill 827 (527 wetland) + 1,931 ac temporary fill at Clifton Court Forebay; Alt 5A would fill 750 (470 wetland). That's a lot of area. The timing and details of mitigation measures are not provided. References to the larger Delta Plan suggest that compensations would come at unknown times. Piecemeal losses such as indicated here: "Only 1% of the habitat in the study area would be filled or converted" (Chapter 12, line 29, page 12-22) is how the US has lost its historical wetlands. What are the overall cumulative impacts of wetland losses in the Delta? What is the tipping point beyond which further wetland losses must be avoided? The proposed project is one part of the broader array of management actions in the Delta and should be considered in that broader context.

Habitat descriptions

How will mudflats be sustained for shorebirds? Exposed mud above half-tide can become vegetated rapidly. In the Delta, the bulrush *Schoenoplectus californicus* tolerates nearly continuous tidal submergence.

Are soils clayey enough for the proposed restoration of up to 34 acres of vernal pool and alkali seasonal wetland near Byron? These areas will need to pond water, not just provide depressions.

12-243, line 18: How would adding lighting to electrical wires eliminate any potential impact to black rails? This mitigation is overstated.

Several of the species accounts (e.g., bank swallow) indicate that there is uncertainty about how construction or operations will impact the species. In most cases, monitoring is proposed to assess what is happening. But to be effective, the monitoring results need to be evaluated and fed into decision-making, as visualized in the adaptive-management process. There is little explicit indication of how this will be done or funded.

Land use (Chapter 13)

Alternative 4A would allow water diversion from the northern Delta, with fish screens, multiple intakes, and diversions limited to flows that exceed certain minima, e.g., 7000 cfs. This would reduce flood-pulse amplitudes and, presumably, downstream flooding. How does this alter opportunities for riparian restoration? Which downstream river reaches are leveed and not planned to support riparian restoration? Where would riparian floodplains still be restorable?

Over what surface area does the pipeline transition to the tunnel? At some point along the pipeline-tunnel transition, wouldn't groundwater flow be affected?

Up to 14 years of construction activities were predicted for some areas (e.g., San Joaquin Co.); this would have cumulative impacts (e.g., dewatering would affect soil compaction, soil carbon, microbial functions, wildlife populations, and invasive species). What about impacts of noise on birds; e.g., how large an area would still be usable by greater sandhill cranes?

State how jurisdictional wetlands have been mapped and how the overall project net gain or net loss of wetland area has been estimated. If mitigation consists only of restoration actions in areas that are currently jurisdictional wetlands, then there would be an overall net loss of wetland area due to the project. A mitigation ratio >1:1 would be warranted to compensate for reduced wetland area. This was also a concern for Chapter 12.

Up to 277 ac of tidal wetlands are indicated as restorable; text should indicate if these are tidal freshwater or tidal brackish wetlands (or saline, as is the typical use of "tidal wetlands").

13-19. On the need to store removed aquatic vegetation until it can be disposed: there are digesters for this purpose, and they might be efficient means of mitigation if management of harvested aquatic plants will be long-term. A waste product could be turned into a resource (methane fuel).

13-19, line 12: Text says that "predator hiding spots" will be removed. What are these?

13-19, line 20: What are the E16 nonphysical fish barriers? An electrical barrier?

13-20, line 19: Boat-washing stations are mentioned; would these discharge pollutants (soap, organic debris?)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

OCT 30 2015

OFFICE OF THE REGIONAL ADMINISTRATOR

David Murillo, Regional Director
Bureau of Reclamation, Mid-Pacific Region
2800 Cottage Way, MP-700
Sacramento, CA 95825

Subject: Supplemental Draft Environmental Impact Statement
Bay Delta Conservation Plan/California WaterFix CEQ# 20150196

Dear Mr. Murillo:

The U.S. Environmental Protection Agency has reviewed the Bay Delta Conservation Plan (BDCP)/California WaterFix Supplemental Draft EIS pursuant to the National Environmental Policy Act, Council on Environmental Quality regulations (40 CFR Parts 1500-1508), and our NEPA review responsibilities under Section 309 of the Clean Air Act. The San Francisco Bay/Sacramento-San Joaquin Delta is an important estuarine system, supporting over 750 species and supplying drinking water to 25 million people and irrigation water to 4 million acres of farmland.

Background
The WaterFix project evolved from the BDCP, which was proposed as a Habitat Conservation Plan (HCP) to support the issuance of a 50-year incidental take permit under Section 10 of the Endangered Species Act (ESA). A joint federal and state Draft Environmental Impact Statement/Draft Environmental Impact Report (DEIS/DEIR) for the BDCP was released on December 13, 2013, with the U.S. Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), and Bureau of Reclamation (Reclamation) as joint federal lead agencies for the DEIS, and the California Department of Water Resources (DWR) as the State lead agency for the DEIR. The BDCP included a major habitat restoration program, targeting over 150,000 acres, as well as a proposed new conveyance facility (tunnels) to transport water from the Sacramento River to existing pumps in the South Delta.

In August 2014, the federal and State lead agencies committed to supplement/recirculate the DEIS/DEIR in response to public comments received on that document, including those submitted by EPA on August 26, 2014. In a collaborative effort to resolve the issues that we had raised, EPA met frequently with DWR and the original federal lead agencies for several months after submitting our comments on the DEIS, and we appreciate the attention given to the analysis of the proposed project's impacts on specific water quality parameters.

In April 2015, Reclamation and DWR announced fundamental changes to the proposed project and changed its name from BDCP to the California WaterFix. The WaterFix project focuses on the construction and operation of proposed new water export intakes on the Sacramento River to divert water into a proposed 40 mile twin tunnel conveyance facility. Reclamation is now the sole lead federal agency. The proposed federal action has changed from implementing a Habitat Conservation Plan under

Section 10 of the ESA to modifying operations of the federal Central Valley Project (CVP) in order to accommodate new water conveyance infrastructure.

Project Benefits

The proposed project and alternatives would provide greater water supply reliability for the users of exported Delta water and would reduce certain adverse impacts of the CVP and State Water Project (SWP) on fish. The SDEIS shows that transporting water in tunnels would reduce the risks to CVP/SWP exports in several ways. The proposed tunnel project would provide greater protection against sudden degradation of exported freshwater caused by the catastrophic failure of the earthen levees in the Delta and the consequent intrusion of saltwater that could foul supplies of water for municipal, agricultural and industrial consumption. Given the potential for earthquakes and floods in the region and the numerous earthen levees encircling the Delta islands, water supply security is a significant concern. Transporting water via tunnels would substantially address longer term threats to export water quality caused by sea level rise, with its concomitant salt water intrusion. The proposed project would also enhance CVP/SWP project flexibility by adding a northern diversion point. The current system, which relies solely on the southerly intakes, provides limited operational flexibility and at times results in reverse flows in Old and Middle Rivers which are associated with decreased survival of endangered fishes. Added flexibility would enable better real-time management of the export operations in response to observed movement of special status fish populations. Furthermore, the SDEIS predicts that flexible use of the proposed new intake facilities, combined with the establishment of biological criteria for operation, the installation of state-of-the-art fish screens, and the reduction of reverse flows in Old and Middle Rivers, would reduce the entrapment of certain fish species into poor habitats and the entrainment of fish into the CVP/SWP system. By making these physical and operational changes in the Delta, the proposed project would address some of the many identified stressors to aquatic resources in the Delta. In addition, although not part of the WaterFix project, the State of California has launched a separate EcoRestore initiative to pursue the restoration and stewardship of 30,000 acres of floodplains, riparian forests, and wetlands within the Delta over the next four years. As this significant conservation effort was not part of the SDEIS, it was not reviewed or rated as part of our NEPA review.

Project Purpose and Need

As stated in the SDEIS, the purpose and need for the WaterFix project, as was the case for the BDCP, is to advance the co-equal goals set forth in the Delta Reform Act of 2009. Those are (1) to provide a more reliable water supply for California, and (2) to protect, restore, and enhance the Delta ecosystem. EPA recognizes the crucial public health, economic, and ecological importance of both goals. The proposed project and the alternatives evaluated in the SDEIS support the water reliability component, but largely defer actions necessary to protect water quality and aquatic life to the future.

As has been discussed throughout the development of this project, the most essential decision for achieving the desired balance between water reliability and restoration of the Bay Delta ecosystem is how freshwater flows through the Delta will be managed. This key decision is not described in the SDEIS and is, instead, deferred to future regulatory processes administered by the State of California in consultation with federal resource and regulatory agencies. The decision by the State of California and Reclamation to defer these decisions means that the impacts of the WaterFix project on the Delta ecosystem cannot be fully evaluated at this time, and that any attempt to describe the environmental impacts of the project is necessarily incomplete. Once those decisions, described below, are concluded, the evaluation of possible impacts and consideration of alternatives can be completed.

Aquatic Habitat and Water Quality

As noted above, the project has been significantly revised since the initial DEIS, yet the SDEIS relies on modeling results that are based on the BDCP alternatives. Information in the SDEIS indicates that the modeling completed for the BDCP alternatives is not necessarily representative of the environmental effects resulting from the WaterFix alternatives. NMFS and FWS concluded in 2008 and 2009, respectively, that continued operation of the CVP/SWP would jeopardize the existence of delta smelt, winter-run Chinook salmon, green sturgeon and several other fish species. Even with the predictive limitations of the modeling, the SDEIS predicts a loss of valuable aquatic habitat for many fish species in the Delta and upstream tributaries due to the combined effects of the WaterFix project, CVP/SWP exports, climate change, and increased water diversions upstream of the Delta in the Sacramento River Basin. These species have experienced sharp population declines in the last decade and showed record low abundance over the last five years. Information presented in the SDEIS shows that the WaterFix project could reduce habitat conditions for delta smelt, winter-run Chinook salmon, green and white sturgeon, striped bass, and American shad, and result in a decline of longfin smelt abundance. For example, according to the SDEIS, winter-run Chinook salmon and sturgeon may be negatively impacted when migrating past new intakes, because significant volumes of freshwater flows are diverted at the intakes resulting in less water that is also of lower quality downstream of the intakes. The SDEIS also predicts that selenium concentrations in sturgeon would increase by 12-19% as a result of the proposed project, and would exceed the FWS and NMFS benchmark for adverse impacts to sensitive species.

The modeling results presented in the SDEIS show predicted exceedances of a salinity standard at both Prisoner's Point and Emmaton. The water quality modeling predicts that the Western Delta and Suisun Marsh will become saltier over time, which is likely to cause increased exceedances of chloride criteria near municipal water supply intakes. Mitigation actions are identified in the SDEIS to prevent exceedances, and the compliance history shows that salinity standards have rarely been exceeded in non-drought years. Nevertheless, if the proposed project operations contribute to a general increase in salinity in the Delta, the flexibility that Reclamation and DWR have to operate the system to ensure that water quality criteria are met will be seriously diminished, and the two agencies will have little room for error in operating the system to protect beneficial uses and achieve the co-equal goals.

While the impacts stated above may be mitigated by appropriately timed increased flows and habitat restoration, the WaterFix project does not propose additional flows in the Delta, nor does it propose significant habitat restoration (See EcoRestore above). CVP/SWP operation scenarios that propose additional outflow, such as BDCP Alternatives 7 and 8 from the DEIS, could provide substantially more water for resident and migratory fish and provide benefits to aquatic life; however, these were not evaluated as alternatives in the SDEIS.

Pending Regulatory Actions

Several pending regulatory actions are important to understanding the full impacts of the project. First, the State Water Resources Control Board (State Water Board) will be acting on Reclamation's and DWR's recent request to add points of freshwater diversion from the South Delta to the Sacramento River in the North Delta (at the northern end of the new conveyance facility). This State regulatory action is likely to include terms and conditions, including flow requirements, that could modify proposed WaterFix operations sufficiently to produce environmental and water supply effects that have not been analyzed in the SDEIS. Additionally, the State Water Board is in the midst of comprehensively updating water quality standards through the Bay Delta Water Quality Control Plan (Bay Delta WQCP). The updated standards could result in freshwater flow management provisions and corresponding changes to water supply diversions throughout the watershed that have not been analyzed

in the SDEIS. The Delta is listed as impaired for several water quality parameters under Section 303(d) of the CWA. EPA is working closely with the State Water Board to ensure that the revised standards are sufficient to address impaired water quality conditions in the Delta and reverse the declines in the fish species. The updated standards could result in altered environmental and water supply impacts that have not been analyzed in the SDEIS.

Second, ESA Section 7 consultation with FWS and NMFS regarding the construction and operation of new conveyance facilities is underway. We understand that the FWS and NMFS are not relying solely on the SDEIS for the Section 7 consultation process and that additional information is being generated to identify criteria for operating the new WaterFix facilities, to be included in the Biological Opinions and Incidental Take Permits. This information and such operating criteria could result in environmental impacts that have not been analyzed in the SDEIS.

Third, construction of WaterFix's new water intake and conveyance infrastructure would require authorization under Clean Water Act Section 404, as well as a Rivers and Harbors Act Section 14 modification of levees permit, from the U.S. Army Corps of Engineers. Water quality and aquatic life analyses in the SDEIS show that the proposed project may cause or contribute to violations of state water quality standards and significant degradation of waters of the U.S.; therefore, additional avoidance and minimization of environmental impacts and/or compensatory mitigation may be necessary in order to comply with CWA Section 404. It is also likely that additional information and analysis not included in the SDEIS will be required to support those permit decisions and that information and analysis will better inform the overall evaluation.

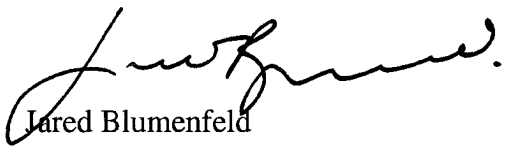
All of the above listed regulatory processes will develop new data and likely new compliance requirements beyond those provided in the SDEIS. EPA understands that these as yet incomplete regulatory requirements will be addressed through the pending actions by the State Water Resources Control Board, FWS, NMFS, and Corps of Engineers. These key decisions, and the analysis that will support them, are not yet done. Our statutory responsibility is to review the NEPA document that is in front of us at this time, however, the reality is that these future regulatory processes will have an important bearing on the project. Because these subsequent regulatory processes are likely to generate real world operational scenarios that are significantly different from the operations proposed in the SDEIS, the information is not yet available to reach definitive conclusions concerning the environmental impacts of the proposed project.

The tunnels that are discussed in detail in this draft NEPA document are an important improvement for water reliability, but the choices that will affect the operation of the tunnels, and thus the overall impacts of the project, will not be made until future regulatory actions are completed. These future decisions will supply the missing pieces necessary to determine the environmental impact of the entire project. The unusual circumstances of this project mean that the information is not yet available for a complete evaluation of environmental impacts – and for that reason a rating of *"3"(Inadequate)* for the SDEIS is required – but EPA expects that the project will continue to move forward, with those necessary additional pieces to be supplied as the later regulatory processes proceed. Under the unique circumstances of this case, the additional data, analysis and public input associated with these future regulatory processes are expected to provide the needed supplemental information to allow a full review of the environmental impacts without requiring another draft supplemental EIS. EPA will have the opportunity to support Reclamation, other federal agencies, and the State of California as they collectively continue to define an environmentally sound and effective project that would operate in a manner that simultaneously supports water supply reliability and enhances the Delta's ecosystem. EPA

believes that the upcoming actions by USFWS, NMFS, the State Water Board, and the Corps of Engineers will be critical next steps in the design and review of the project, and EPA looks forward to continuing to work with these agencies as the project moves forward.

If you have any questions, please contact me at 415-947-8702. Alternatively, your office may contact Kathleen Johnson, Enforcement Division Director. Ms. Johnson can be reached at 415-972-3873.

Sincerely,



Jared Blumenfeld

IMPLEMENTING AGREEMENT

for the

BAY DELTA CONSERVATION PLAN

by and among

THE UNITED STATES FISH AND WILDLIFE SERVICE

THE NATIONAL MARINE FISHERIES SERVICE

THE CALIFORNIA DEPARTMENT OF WATER RESOURCES

THE CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

AND

STATE WATER PROJECT/CENTRAL VALLEY PROJECT CONTRACTORS

DRAFT

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Exhibits

Exhibit A: **List of Covered Species**

Exhibit B: **BDCP Plan Area**

Exhibit C: **Certificate of Inclusion Template**

Exhibit D: **BDCP Implementation Schedule**

Exhibit E: **Natural Lands Conservation Easement Template**

Exhibit F: **Agricultural Lands Conservation Easement Template**

Exhibit G: **Notice List**

Exhibit H: **SWP/CVP Contractors that are Parties**

1.0 PARTIES TO THIS AGREEMENT

This Implementing Agreement (Agreement) is made and entered into by and among the State of California, acting through the California Department of Water Resources (DWR) and the California Department of Fish and Wildlife (CDFW) of the State of California Natural Resources Agency, certain State Water Project and Central Valley Project contractor water agencies (SWP/CVP Contractors), and the United States, acting through the Fish and Wildlife Service (USFWS) of the United States Department of the Interior and the National Marine Fisheries Service (NMFS) of the United States Department of Commerce. This Agreement governs the implementation of the joint habitat conservation plan (HCP) and natural community conservation plan (NCCP) for the Sacramento–San Joaquin Delta (Bay Delta Conservation Plan, Plan, or BDCP). [Note to Reviewers: the parties will further consider the level of agency signatory prior to the release of the final Implementing Agreement].

The United States Bureau of Reclamation (Reclamation) of the United States Department of the Interior is not a Party to this Agreement. References to Reclamation's roles and responsibilities in this Agreement reflect those as set forth in the BDCP. There are no obligations on behalf of Reclamation established in this Agreement.

2.0 RECITALS AND PURPOSES OF THE AGREEMENT

2.1 Recitals

The Parties have entered into this Agreement in consideration of the following facts:

2.1.1 The DWR is a State agency within the California Natural Resources Agency charged with responsibility for operating and maintaining the State Water Project's existing facilities, including the Clifton Court Forebay and the Banks Pumping Plant. DWR enters into this Agreement pursuant to the Burns–Porter Act and other applicable laws of the State of California.

2.1.2 The SWP/CVP Contractors receive water under contract from the State Water Project and the Central Valley Project. The SWP/CVP Contractors will participate in various aspects of the implementation of the BDCP, including the funding and implementation of certain portions of the Conservation Measures.

2.1.3 The USFWS is a federal agency within the United States Department of the Interior charged with responsibility for administering the federal Endangered Species Act (ESA) and providing for the conservation of federally listed fresh water aquatic and terrestrial species and their habitat. USFWS is

authorized to issue take permits under Section 10(a)(1)(B) of the ESA for the incidental take of federally listed fresh water aquatic and terrestrial species provided that applicants for such permits submit an HCP that meets permit issuance criteria set forth in Section 10 of the ESA and its implementing regulations. USFWS enters into this Agreement pursuant to the ESA, the Fish and Wildlife Coordination Act, and the Fish and Wildlife Act of 1956.

2.1.4 The NMFS is a federal agency within the United States Department of Commerce charged with responsibility for administering the ESA and providing for the conservation of federally listed anadromous and marine species and their habitat. NMFS is authorized to issue take permits under Section 10(a) of the ESA for the incidental take of federally listed anadromous and marine species provided that applicants for such permits submit an HCP that meets permit issuance criteria set forth in Section 10 of the ESA. NMFS enters into this Agreement pursuant to the ESA and its implementing regulations.

2.1.5 CDFW is a State agency within the California Natural Resources Agency charged with responsibility for administering the Natural Community Conservation Planning Act (NCCPA). CDFW is authorized to issue permits under Section 2835 of the Fish & Game Code to authorize the take of any species, whether or not it is listed as an endangered, threatened, candidate, or fully protected species under State law, where the conservation and management of the species is provided for in an NCCP approved by CDFW. CDFW enters into this Agreement pursuant to the NCCPA.

2.1.6 The U.S. Bureau of Reclamation (Reclamation) is a federal agency within the United States Department of the Interior charged with responsibility for operating and maintaining the Central Valley Project's existing Delta facilities, including the Jones Pumping Plant and Delta Cross Channel. Reclamation is not a permit applicant for the BDCP under the ESA or NCCPA. However, Reclamation is a participant in the BDCP.

2.1.7 In October 2006, Reclamation, the Parties and several other entities entered into a Planning Agreement that identified the goals, objectives, guidelines, criteria and procedures for the preparation of a joint HCP and NCCP (Planning Agreement). A First Amendment to the Planning Agreement was executed in 2009. The BDCP and this Agreement have been prepared in accordance with the Planning Agreement.

2.1.8 The overall goal of the BDCP is to restore and protect ecosystem health, water supply, and water quality within a stable regulatory framework. To accomplish this goal, the Plan:

- Provides for the conservation and management of Covered Species within the Plan Area through the preservation, restoration, and enhancement of aquatic, riparian and associated terrestrial natural communities and ecosystems that support these Covered Species and through other conservation actions.

- Includes measures to minimize and mitigate to the maximum extent practicable the effects on the Covered Species.

- Provides a means by which Covered Activities and Associated Federal Actions can be carried out in a manner that complies with applicable State and federal environmental laws.

- Sets out a comprehensive approach to coordinating and standardizing applicable requirements for Covered Activities and Associated Federal Actions within the Plan Area.

- Provides an allocation of responsibility among the Parties for BDCP requirements, taking into account the impacts of the Covered Activities and Associated Federal Actions.

- Establishes a more efficient and effective approach to regulatory compliance with State and federal endangered species laws than through project-by-project, species-by-species permitting.

- Provides clear expectations and Assurances and Protections.

2.1.9 The provisions of the BDCP were developed to satisfy the requirements of the Sacramento–San Joaquin Delta Reform Act of 2009, California Water Code (Water Code) § 85300 *et seq.*

2.1.10 DWR and the participating SWP/CVP Contractors have submitted the BDCP to USFWS and NMFS for the purpose of obtaining incidental take authorizations under Section 10(a)(1)(B) of the ESA for the species covered by the BDCP, as appropriate, within the Plan Area.

2.1.11 Reclamation has incorporated the BDCP into a biological assessment to support a Section 7 consultation for Reclamation's

actions within the Plan Area and the resulting Integrated Biological Opinion and related Incidental Take Statement that will be issued prior to the execution of this Agreement.

2.1.12 DWR and the SWP/CVP Contractors have submitted the BDCP to CDFW for the purpose of obtaining a permit for take of the Covered Species within the Plan Area pursuant to Section 2835 of the NCCPA.

2.1.13 DWR and the participating SWP/CVP Contractors are agreeing to substantial commitments of water, land, other natural resources, financial resources, human resources and other assets to provide for the conservation and management of the Covered Species, their habitats and other natural communities, in exchange for the Fish and Wildlife Agencies providing take authorizations, and the Assurances.

2.2 Purposes

The purposes of this Agreement are to:

- Clarify the provisions of the BDCP and the processes the Parties intend to follow to ensure successful implementation of the BDCP in accordance with the take authorizations and applicable law.

- Ensure that each of the terms and conditions of the BDCP, this Agreement, the Permits, and the Incidental Take Statement are properly implemented.

- Set forth the remedies and recourse should any Party fail to perform its obligations.

- Delineate the responsibilities, financial or otherwise (including the commitment and management of resources), among the entities responsible for the financing and/or implementation of the BDCP.

- Satisfy the requirement that an NCCP include an implementation agreement containing provisions described in the NCCPA.

- Set out the Assurances and Protections provided to the Authorized Entities.

3.0 DEFINITIONS

The following terms as used in this Agreement will have the meanings set forth below. Terms specifically defined in State or Federal statutes, including the ESA or the NCCPA, or the regulations adopted under those statutes, shall have the same meaning when used in this Agreement. Where such terms are defined in this Section 3.0, those definitions may elaborate on, but are not intended to conflict with, such statutory or regulatory definitions.

3.1 "Adaptive Management Team" means the team that will have primary responsibility for the development of performance measures, effectiveness monitoring and research plans; analysis, synthesis and evaluation of monitoring and research results; solicitation of independent scientific review; development of proposals to modify Conservation Measures and biological objectives and other actions set out in Chapter 3.6. The Adaptive Management Team will be chaired by the Science Manager, and will consist of representatives of DWR, Reclamation, the two participating SWP/CVP Contractors (a single representative of the SWP Contractors, a single representative of the CVP Contractors), CDFW, USFWS and NMFS as voting members. Advisory, non-voting members will be the Lead Scientist for the Interagency Ecological Program, the Lead Scientist for the Delta Science Program or a designee, and the Director of the NOAA Southwest Fisheries Science Center.

3.2 "Agreement" means this Implementing Agreement, which incorporates the BDCP by reference.

3.3 "Annual Progress Report" means the annual report prepared by the Implementation Office, as provided in Section 16.3.1.

3.4 "Associated Federal Actions" means the otherwise lawful activities and projects described in Chapter 4 that may be implemented in the Plan Area by Reclamation for which Incidental Take is authorized by USFWS and NMFS pursuant to the Incidental Take Statement in the Integrated Biological Opinion.

3.5 "Assurances and Protections" shall mean (1) the assurances provided to the Permittees by USFWS and NMFS pursuant to the "No Surprises" rule and by CDFW pursuant to Fish & Game Code Section 2820(f); and (2) the procedural mechanisms provided to Reclamation by USFWS and NMFS pursuant to the terms of the Memorandum and as described in this Agreement.

3.6 "Authorized Entities" means DWR, Reclamation, and those SWP/CVP Contractors that receive take authorizations pursuant to the BDCP.

3.7 "Authorized Entity Group" means the group established to provide program oversight and general guidance to the Program Manager regarding the implementation of the Plan. The Authorized Entity Group will consist of the Director of DWR, the Regional Director for Reclamation, a representative of the participating SWP Contractors, and a representative of the participating CVP Contractors, or their designees.

Such designee shall be duly authorized to exercise the authority of the principal and may include a deputy or principal assistant.

3.8 "Bay Delta Conservation Plan," "BDCP" and "Plan" mean the joint HCP and NCCP prepared by the Permittees in coordination with Reclamation and with the technical assistance of the Fish and Wildlife Agencies.

3.9 "Central Valley Project" or "CVP" means the Central Valley Project, as defined in 3404(d) of Title XXXIV of Public Law 102-575, and operated by Reclamation.

3.10 "Central Valley Project Improvement Act" or "CVPIA" means Title XXXIV of Public Law 102-575.

3.11 "CEQA" means the California Environmental Quality Act (Cal. Pub. Res. Code §§ 21000–21177) and all rules, regulations and guidelines promulgated pursuant to that Act.

3.12 "CESA" means the California Endangered Species Act (Fish & Game Code §§ 2050–2116) and all rules, regulations and guidelines promulgated pursuant to that Act.

3.13 "Changed Circumstances," as defined by 50 C.F.R. § 17.3 and § 222.102, means changes in circumstances affecting a species or the geographic area covered by the BDCP that have been reasonably anticipated by the Parties and that have been planned for in the BDCP. "Changed Circumstances" are defined under Fish & Game Code § 2805 (c) to mean reasonably foreseeable circumstances that could affect a Covered Species or the Plan Area. Changed Circumstances and planned responses to those circumstances are described in Chapter 6.4.2. Changes in circumstances that are not identified as Changed Circumstances will be treated as unforeseen circumstances.

3.14 "Chapter" means a chapter, subchapter, or section of the BDCP.

3.15 "Consensus" means that either all voting members of the Adaptive Management Team or all voting members of the Real Time Operations Team agree to the proposal at hand, or that no voting member dissents from the proposal.

3.16 "Conservation Measure" means each action detailed in the Conservation Strategy in Chapter 3 to minimize and mitigate impacts, to the maximum extent practicable, and to provide for the conservation and management of Covered Species.

3.17 "Conservation Strategy" means the program described in Chapter 3 that consists of four components: (1) biological goals and objectives; (2) Conservation Measures; (3) adaptive management; and (4) monitoring.

3.18 "Coordinated Operation Agreement" means the Agreement between the United States of America and the State of California for the Coordinated Operation of the Central Valley Project and the State Water Project dated November 24, 1986.

3.19 "Covered Activities" means the otherwise lawful activities and projects described in Chapter 4 that may be implemented in the Plan Area by non-federal Parties for which take is authorized by the Fish and Wildlife Agencies pursuant to the Permits.

3.20 "Covered Species" means the species, listed and non-listed, for which take may be authorized and for which the BDCP provides measures to minimize and mitigate, to the maximum extent practicable, the impacts of Covered Activities, and provides for the conservation and management of those species. Covered Species are listed in Exhibit A to this Agreement.

3.21 "Delta" and "Sacramento–San Joaquin Delta" mean the Sacramento–San Joaquin Delta as defined in Water Code § 12220.

3.22 "CDFW" means the California Department of Fish and Wildlife, a department of the California Natural Resources Agency.

3.23 "Effective Date" means the date on which this Agreement takes effect, as provided in Section 21.1.

3.24 "ESA" means the Federal Endangered Species Act of 1973, as amended (16 U.S.C §§ 1531–1544) and all rules, regulations and guidelines promulgated pursuant to that Act.

3.25 "Federally Listed Species" means the species that are listed as threatened or endangered species under the ESA. See 50 C.F.R. § 17.11.

3.26 "Federal Permits" means the federal Incidental Take Permits issued by USFWS and NMFS to the Permittees, pursuant to Section 10(a)(1)(B) of the ESA.

3.27 "Fish and Wildlife Agencies" means USFWS, NMFS and CDFW.

3.28 "Fully Protected Species" means the Covered Species that are identified in Fish & Game Code sections 3511, 4700, 4800, 5050 and 5515.

3.29 "Implementation Office" means the office that, under the direction of a Program Manager, will manage, coordinate, oversee, and report on all aspects of Plan administration, subject to the oversight of the Authorized Entity Group and certain limitations set out in the BDCP and this Agreement, as further described in Section 15.2.

3.30 "Incidental Take" under federal ESA means the take of a covered fish or wildlife species that results from, but is not the purpose of, carrying out an otherwise lawful activity.

3.31 "Incidental Take Statement" means the statement that is attached to the integrated biological opinion that is issued by USFWS and NMFS. It anticipates and authorizes the amount or extent of take for federally listed species.

3.32 "Integrated Biological Opinion" means the joint biological opinion that is issued by USFWS and NMFS to complete the Section 7 consultation associated with the BDCP. The Integrated Biological Opinion will also serve as a Conference Opinion for certain Covered Species and proposed critical habitat.

3.33 "Listed Species" means State Listed Species or Federally Listed Species.

3.34 "Memorandum" means a separate memorandum, or similar agreement, describing Reclamation's roles and responsibilities in the implementation of BDCP.

3.35 "Migratory Bird Treaty Act" means the federal Migratory Bird Treaty Act (16 U.S.C. §§ 703–712) and all rules, regulations and guidelines promulgated pursuant to that Act.

3.36 "NMFS" means the National Marine Fisheries Service, an agency of the Department of Commerce.

3.37 "NCCPA" means the California Natural Community Conservation Planning Act (Fish & Game Code §§ 2800–2835), and all rules, regulations and guidelines promulgated pursuant to that Act.

3.38 "NEPA" means the National Environmental Policy Act (42 U.S.C. §§ 432–4347) and all rules, regulations and guidelines promulgated pursuant to that Act.

3.39 "Non-listed Species" means a species that is not listed as endangered or threatened under the ESA or is not listed as endangered or threatened, or designated as a candidate for such status, under CESA.

3.40 "NPPA" means the California Native Plant Protection Act (Fish & Game Code §§ 1900–1913) and all rules, regulations, and guidelines promulgated pursuant to that Act.

3.41 "Other Authorized Entities" means the entities described in Chapter 7.1.2.2 that receive take authorizations through the Permits issued to DWR.

3.42 "Other Stressors Conservation Measures" means a certain category of conservation measures, as described in Conservation Measures 13–21.

3.43 "Party" and "Parties" mean the signatories to this Agreement, individually and collectively.

3.44 "Permit Oversight Group" means the State and federal fish and wildlife agencies, specifically, the Regional Director of USFWS, the Regional Administrator of NMFS, and the Director of CDFW or their designees. Such designee shall be duly authorized to exercise the authority of the principal and may include a deputy or principal assistant.

3.45 "Permits" mean the Federal Permits and the State Permit.

3.46 "Permittees" means DWR and the SWP/CVP Contractors.

3.47 "Plan Area" means the area covered by the BDCP, as described in Chapter 1 and depicted in Exhibit B of the Plan.

3.48 "Planning Agreement" means the Planning Agreement regarding the Bay Delta Conservation Plan executed in October of 2006 by the Parties, Reclamation and several other entities, as amended in 2009.

3.49 "Reserve Unit Management Plan" means a Reserve Management Plan as described in Chapter 3.4.11.2.2.

3.50 "Reserve System" means the assemblage of land acquired and dedicated in perpetuity by either fee interest or conservation easement that is designed to advance the preservation, conservation, enhancement and restoration objectives of the Conservation Strategy of the BDCP.

3.51 "Rough Proportionality" means implementation of BDCP Conservation Measures that is roughly proportional in time and extent to the impact on habitat or Covered Species authorized under the BDCP and as required by Fish & Game Code § 2820(b)(9).

3.52 "State-Listed Species" means the species that are listed as threatened or endangered species, or a candidate for such status, under CESA, as fully protected species under the Fish & Game Code, or as rare species under the NPPA. See Cal. Code Regs., tit. 14, §§ 670.2, 670.5, Fish & Game Code §§3511, 4700, 4800, 5050 and 5515. Published notifications in the California Regulatory Notice Register identify candidate species.

3.53 "State Permit" means the State NCCPA take Permit issued to the Permittees pursuant to Section 2835 of the Fish & Game Code.

3.54 "State Water Project" or "SWP" means the State Water Project as authorized by Water Code sections 12930 *et seq*. and Water Code sections 11100 *et seq*. and operated by DWR.

3.55 "Supporting Entity" means an agency, organization or individual that performs certain Plan implementation tasks, at the request of the Program Manager, as provided in Section 15.7 and further described in Chapter 7.1.9.

3.56 "SWP/CVP Contractors" means the individual water agencies that hold water delivery contracts with DWR for SWP water (SWP Contractors) or Reclamation for CVP water (CVP Contractors), or an entity comprising such agencies, and that have executed this Agreement. SWP/CVP Contractors may include the State and Federal Water Contractors Agency (SFWCA), a joint exercise of powers agency, and the San Luis & Delta Mendota Water Authority (SLDMWA), a joint exercise of powers agency. The SWP/CVP Contractors are listed on Exhibit H to this Agreement.

3.57 "Take" and "Taking" mean, in the context of the ESA to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in such conduct. 16 U.S.C. § 1532(19)and in the context of the Fish & Game Code Section 86 mean to hunt, pursue, catch, capture, or kill or attempt to hunt, pursue, catch, capture, or kill.

3.58 "Take Authorizations" means the Federal Permits, the State Permit, and the Incidental Take Statement issued with the Integrated Biological Opinion to collectively authorize take associated with Covered Activities and Associated Federal Actions.

3.59 "Unforeseen Circumstances" means (a), in the context of the ESA, changes in circumstances affecting a Covered Species or geographic area covered by the BDCP that could not reasonably have been anticipated by the Permittees, USFWS or NMFS at the time of the BDCP's negotiation and development, and that result in a substantial and adverse change in the status of a Covered Species (50 C.F.R. §§17.2 and 222.102), and (b), in the context of the NCCPA, changes affecting one or more species, habitats, natural communities, or the geographic area covered by a conservation plan that could not reasonably have been anticipated at the time of Plan development, and that result in a substantial adverse change in the status of one or more Covered Species (Fish & Game Code § 2805(k)).

3.60 "USFWS" means the United States Fish and Wildlife Service, an agency of the United States Department of the Interior.

4.0 FINDINGS

4.1 Findings by USFWS and NMFS

As part of their findings, USFWS and NMFS will make certain determinations, after opportunity for public comment, regarding the adequacy of the BDCP to meet the permitting requirements of the ESA. To issue Permits pursuant to the BDCP, USFWS and NMFS must find that: (1) the taking of Covered Species within the Plan Area in accordance with the BDCP will be incidental to the carrying out of otherwise lawful activities; (2) the actions set forth in the BDCP will, to the maximum extent practicable, monitor, minimize and mitigate the impacts of such incidental taking; (3) adequate assurances of funding to implement the BDCP have been provided; (4) the requested taking of Covered Species will not appreciably reduce the likelihood of survival and recovery of such species in the wild or result in the destruction or adverse modification of critical habitat; and (5) the BDCP contains all measures deemed necessary and appropriate by USFWS and NMFS for the purposes of Section 10 of the ESA.

4.2 Findings by CDFW

4.2.1 NCCPA

In a separate document, entitled the "Findings of Fact and NCCPA Permit for the Bay Delta Conservation Plan," CDFW will make certain findings, after opportunity for public comment, regarding the adequacy of the BDCP and this Agreement to meet the permitting requirements of the NCCPA. To issue a Permit under the NCCPA, CDFW must find that the BDCP adequately provides for the conservation and management of Covered Species and their habitat and otherwise satisfies all legal requirements under Section 2820 of the Fish & Game Code, as follows:

(1) The BDCP has been developed consistent with the process identified in the Planning Agreements entered into pursuant to Fish & Game Code § 2810.

(2) The BDCP integrates adaptive management strategies that are periodically evaluated and modified based on the information from the monitoring program and other sources, which will assist in providing for the conservation of Covered Species and ecosystems within the Plan Area.

(3) The BDCP provides for the protection of habitat, natural communities, and species diversity on a landscape or ecosystem level through the creation and long-term management of habitat reserves or other measures that provide equivalent conservation of Covered Species appropriate for land, aquatic, and marine habitats within the Plan area.

(4) The development of reserve systems and conservation measures in the Plan Area provides, as needed to provide for the conservation of species, all of the following:

(A) Conserving, restoring, and managing representative natural and semi-natural landscapes to maintain the ecological integrity of large habitat blocks, ecosystem function, and biological diversity.

(B) Establishing one or more reserves or other measures that provide equivalent conservation of Covered Species within the Plan Area and linkages between them and adjacent habitat areas outside of the Plan Area.

(C) Protecting and maintaining habitat areas that are large enough to support sustainable populations of Covered Species.

(D) Incorporating a range of environmental gradients (such as slope, elevation, aspect, and coastal or inland characteristics) and high habitat diversity to provide for shifting species distributions due to Changed Circumstances.

(E) Sustaining the effective movement and interchange of organisms between habitat areas in a manner that maintains the ecological integrity of the habitat areas within the Plan Area.

(5) The BDCP identifies activities, and any restrictions on those activities, allowed within reserve areas that are compatible with the conservation of species, habitats, natural communities, and their associated ecological functions.

(6) The BDCP contains specific Conservation Measures that are intended to meet the biological needs of Covered Species and that are based upon the best available scientific information regarding the status of Covered Species and the impacts of permitted activities on those species.

(7) The BDCP contains a monitoring program.

(8) The BDCP contains an adaptive management program.

(9) The BDCP includes the estimated timeframe and process by which the reserves or other Conservation Measures are to be implemented, including obligations of the Plan signatories and consequences of the failure to implement such measures in a timely manner.

(10) The BDCP contains provisions that ensure adequate funding to carry out the conservation actions identified in the BDCP.

(11) This Agreement includes provisions defining species coverage, including any conditions of coverage.

(12) This Agreement includes provisions for establishing the long-term protection of any habitat reserve or other measures that provide equivalent conservation of Covered Species.

(13) This Agreement includes specific terms and conditions, which, if violated, would result in the suspension or revocation of the State Permit, in whole or in part. These terms and conditions address, but are not limited to, provisions specifying the actions CDFW shall take under all of the following circumstances:

(A) If the Permittees fail to provide adequate funding.

(B) If the Permittees fail to maintain the Rough Proportionality between impacts on habitat or Covered Species and Conservation Measures.

(C) If the Permittees adopt, amend, or approve any plan or project without the concurrence of the CDFW that is inconsistent with the objectives and requirements of the approved Plan.

(D) If the level of Take exceeds that authorized by the State Permit.

(14) This Agreement includes provisions specifying procedures for amendment of the Plan and this Agreement.

(15) This Agreement includes provisions ensuring implementation of the monitoring program and adaptive management program.

(16) This Agreement includes provisions for oversight of Plan implementation for purposes of assessing mitigation performance, funding, and habitat protection measures.

(17) This Agreement includes provisions for periodic reporting to CDFW and the public for purposes of information and evaluation of Plan progress.

(18) This Agreement includes mechanisms to ensure adequate funding to carry out the conservation actions identified in the Plan.

(19) This Agreement includes provisions to ensure that implementation of Conservation Measures on a Plan basis is roughly proportional in time and extent to the impact on habitat or Covered Species authorized under the Plan.

As required by Fish & Game Code, Section 2821, concurrent with its approval of the BDCP, the CDFW will establish a list of species that are authorized for take pursuant to Fish & Game Code, Section 2835, and make specific findings to support coverage pursuant to Fish & Game Code, Section 2820. CDFW must further determine whether

the mitigation measures specified in the Plan are consistent with Fish & Game Code, Section 2801, subdivision (d).

4.2.2 The Sacramento-San Joaquin Delta Reform Act of 2009

CDFW has found that the BDCP satisfies the requirements of the Sacramento–San Joaquin Delta Reform Act of 2009, Water Code sections 85300 *et seq*. Specifically, as required by Water Code, Section 85320, CDFW has found:

- The BDCP complies with Chapter 10 (commencing with Section 2800) of Division 3 of the Fish & Game Code such that the BDCP can be approved as an NCCP.

- The Environmental Impact Report (EIR) prepared for the BDCP complies with Division 13 (commencing with Section 21000) of the California Public Resources Code, including by providing a comprehensive review and analysis of all of the following:

    - A reasonable range of flow criteria, rates of diversion, and other operational criteria required to satisfy the criteria for approval of a natural community conservation plan as provided in subdivision (a) of Section 2820 of the Fish & Game Code, and other operational requirements and flows necessary for recovering the Delta ecosystem and restoring fisheries under a reasonable range of hydrologic conditions, which will identify the remaining water available for export and other beneficial uses.

    - A reasonable range of Delta conveyance alternatives, including through-Delta, dual conveyance, and isolated conveyance alternatives and including further capacity and design options of a lined canal, an unlined canal, and pipelines.

    - The potential effects of climate change, possible sea level rise up to 55 inches, and possible changes in total precipitation and runoff patterns on the conveyance alternatives and habitat restoration activities considered in the EIR.

    - The potential effects on migratory fish and aquatic resources.

    - The potential effects on Sacramento River and San Joaquin River flood management.

    - The resilience and recovery of Delta conveyance alternatives in the event of catastrophic loss caused by earthquake or flood or other natural disaster.

- The potential effects of each Delta conveyance alternative on Delta water quality.

- In compliance with Water Code Section 85321, the BDCP includes a transparent, real-time operational decision making process in which fishery agencies ensure that applicable biological performance measures are achieved in a timely manner with respect to water system operations.

5.0 ROLE OF BUREAU OF RECLAMATION IN THE BDCP

Federal agencies, such as Reclamation, comply with the ESA through the Section 7 consultation process and not through the Section 10 HCP permitting process. Given the scale of Reclamation's CVP operations and the degree to which these operations are coordinated with the SWP, BDCP has been designed to address both SWP and CVP operations in the Delta. Reclamation will enter into a Memorandum, or similar agreement, with the Parties that sets out Reclamation's roles and responsibilities pursuant to the BDCP and establishes processes to ensure that Reclamation's actions are implemented in a manner consistent with the Plan.

6.0 INCORPORATION OF THE BDCP

The BDCP and each of its provisions are intended to be, and by this reference are, incorporated herein; provided, wherever possible, the terms of this Agreement and the terms of the BDCP shall be interpreted to be supplementary to each other; provided further, in the event of a direct conflict between the terms of this Agreement and the BDCP, the terms of this Agreement shall control.

7.0 GENERAL OBLIGATIONS OF THE PARTIES

7.1 Authorized Entities

The Authorized Entities will fulfill all of their respective obligations under this Agreement, the BDCP, the Permits and the Integrated Biological Opinion. The Authorized Entities' general obligations include:

- Implementing the Conservation Measures and other BDCP actions as specified in the Plan, in Chapter 3 and this Agreement.

- Participating in the Authorized Entity Group as described in Chapter 7.1.3.

- Participating in the Adaptive Management and Monitoring Program.

- Participating in the scientific research program.

- Conferring with the Implementation Office and Permit Oversight Group regarding Plan implementation matters and obtaining concurrence or approval of Permit Oversight Group where required.

- Funding a portion of the Conservation Strategy.

7.2 Fish and Wildlife Agencies

The Fish and Wildlife Agencies will fulfill all of their respective obligations under this Agreement, the BDCP, the Permits and the Integrated Biological Opinion. The Fish and Wildlife Agencies' general obligations include:

- Participating in the Permit Oversight Group.

- Participating in the Adaptive Management and Monitoring Program.

- Participating in the scientific research program.

- Conferring with the Implementation Office regarding Plan implementation matters.

- Providing one written communication, to the maximum extent practicable, for responses, reviews, concurrence, acceptance, or approvals of BDCP reports, plans, and other documents.

- Funding a portion of the Conservation Strategy.

- Adhering to the Assurances and Protections provided under this Agreement.

- Investigating and taking appropriate steps to further reduce the adverse effect of all factors that stress the fish and wildlife species dependent upon the Bay-Delta estuary.

- Providing assistance to third parties engaged in activities in the Delta to help ensure that such activities proceed in compliance with State and federal endangered species laws and in a manner that does not compromise the likelihood of success of the BDCP.

- Implementing, where appropriate, certain BDCP actions as specified in the Plan and this Agreement.

7.3 Collaboration Among Parties

The Parties agree that frequent collaboration is essential to the success of the BDCP. Each Party will use its best efforts and act in good faith to: meet and confer with any other Party upon the request of that Party to address matters pertaining to the BDCP, the Permits, or this Agreement; provide relevant, non-proprietary, non-confidential information pertaining to the BDCP upon the request of any Party; provide timely responses to requests from any Party for advice, concurrence, or review and comment on reports, surveys or other documents, regarding matters pertaining to the BDCP, the Permits, or this Agreement; accomplish implementation tasks assigned to a Party by the Implementation Office consistent with the direction given; and cooperate, to the fullest extent possible, on matters important to the successful implementation of the BDCP and achievement of the purposes of the Plan.

8.0 TAKE AUTHORIZATIONS

The Fish and Wildlife Agencies have found that the BDCP fulfills the requirements of the ESA and the NCCPA for the issuance by the Fish and Wildlife Agencies of Take Authorizations for the Covered Activities and Associated Federal Actions.

8.1 Take Authorizations Issued to Authorized Entities

8.1.1 Permittees

Concurrent with their execution of this Agreement, the USFWS and NMFS will each issue a Federal Permit to DWR and the SWP/CVP Contractors that authorizes the incidental take of Covered Species resulting from Covered Activities, and CDFW will issue a State Permit to DWR and the SWP/CVP Contractors that authorizes the take of Covered Species resulting from Covered Activities.

The take authorizations will cover the Permittees, including all of their respective officers, directors, employees, agents, subsidiaries, member agencies, contractors, and the Supporting Entities, as applicable, who engage in any Covered Activity. All contracts between Permittees and any such person or entity regarding the implementation of a Covered Activity will require compliance with the Permits, and Permittees shall remain ultimately responsible for compliance with the Permits.

8.1.2 Reclamation

USFWS and NMFS will issue an Incidental Take Statement in the Integrated Biological Opinion that authorizes take of Federally Listed Covered Species for Associated Federal Actions carried out by Reclamation and/or its agents and contractors, as described in Chapter 4.

8.2 Take Authorizations Issued to Other Authorized Entities

Through CM 21, certain third parties may seek take authorizations under the BDCP for ongoing operation of water diversions that are not associated with the SWP or CVP, and for remediation actions associated with those diversions, as described in Chapter 4. Those third parties who participate in the remediation program described in CM21 will be considered Other Authorized Entities.

Other Authorized Entities will receive take authorizations through DWR for the operation of their non-project diversions and for associated remediation actions through the Permits. An Other Authorized Entity will receive take authorization after executing a Certificate of Inclusion that meets the minimum requirements of the template set forth in Exhibit C of this Agreement and that has been approved by the Fish and Wildlife Agencies as to the specific Other Authorized Entity, to ensure compliance with the terms and conditions of the Plan and Permits. The Implementation Office will issue the Certificates of Inclusion for the State Permit and the Federal Permit issued by USFWS, and NMFS will issue the Certificates of Inclusion for the Federal Permit issued by NMFS after receiving a recommendation from the Implementation Office. The USFWS, NMFS, and CDFW agree and acknowledge that DWR shall not be liable for any violations of the terms and conditions of the Certificate of Inclusion that are committed by an Other Authorized Entity, provided the Fish and Wildlife Agencies have approved or issued the applicable Certificate of Inclusion. The Certificate of Inclusion shall be withdrawn and any Take authorization extended to the Other Authorized Entity shall be terminated by the Implementation Office and/or the Fish and Wildlife Agencies if the Other Authorized Entity fails to comply with such terms and conditions. Other Authorized Entities will not be members of the Authorized Entity Group nor will they have a specific role in the governance of the BDCP, other than as potential members of the Stakeholder Council. Other Authorized Entities shall remain responsible for compliance with other applicable laws.

8.3 Timing of Take Authorizations

As of the Effective Date, the Authorized Entities may take the Covered Species as a result of the implementation of Covered Activities and Associated Federal Actions in the Plan Area consistent with the provisions of this Agreement, the BDCP, the Integrated Biological Opinion, and the take authorizations.

8.4 No Take Beyond that Authorized

If CDFW determines, after conferring with the Implementation Office, that take is occurring beyond that authorized by the State Permit, CDFW, at its discretion, may suspend or revoke the State Permit, in whole or in part, pursuant to the procedures in Section 22.4 of this Agreement. Modifications to the BDCP through adaptive management or other provisions of the Plan that would result in an increase in take of Covered Species beyond that analyzed in the BDCP are not authorized. Any such

modification must be proposed, reviewed, and approved as an HCP and/or NCCP amendment in accordance with Section 23.3 of this Agreement.

8.5 Take Authorizations for Non-listed Covered Species

8.5.1 Federal Permits

Covered Species that have not been listed as of the Effective Date as threatened or endangered under the ESA have been treated in the BDCP as if they are Listed Species. In the event a Non-listed Covered Species becomes a Federally Listed Species in the future, incidental take of that species will, without any further action on the part of the Permittees, be automatically authorized by the Federal Permits pursuant to the terms of the BDCP and this Agreement.

8.5.2 Section 7 Consultations

Under the provisions of Section 7 and its implementing regulations, Incidental Take Statements contained in biological opinions apply only to species listed as endangered or threatened under the ESA. The Integrated Biological Opinion also serves as a conference opinion pursuant to 50 C.F.R. § 402.10(d) and (e) that evaluates all Covered Species as though listed and provides a basis for authorizing incidental take should non-listed Covered Species become listed in the future. In the event a Non-listed Covered Species becomes listed in the future, USFWS and NMFS will adopt the conference opinion as the final biological opinion for that species in accordance with 50 C.F.R. § 402.10(d) for Associated Federal Actions undertaken by Reclamation unless significant changes have occurred in the proposed action or the information used in the conference opinion. If the conference opinion can be adopted pursuant to 50 C.F.R. § 402.10(d), USFWS and NMFS will not request, impose, recommend, or require mitigation, conservation, compensation, enhancement, or other protection for such Covered Species, beyond that expressly provided in this Agreement.

8.5.3 State Permit

Under the NCCPA, take of unlisted species may be authorized under a Section 2835 permit. The State Permit authorizes the take of all Covered Species as of the Effective Date, regardless of whether they have been listed under State law.

8.6 Take Authorizations for Fully Protected Species

CDFW acknowledges and agrees that the BDCP includes measures that are intended to avoid, to the maximum extent practicable, the take of any Fully Protected Species as a result of the implementation of Covered Activities. However, if implementation of Covered Activities causes the take of a Fully Protected Species that is also a Covered Species, CDFW acknowledges and agrees that the take is authorized under the State Permit, pursuant to Fish & Game Code § 2835.

8.7 Take Authorizations for Plant Species Under the ESA

The take of Covered Species that are federally listed plants is not prohibited under the ESA, and therefore take authorization for federally listed plants is not necessary. Plant species included on the list of Covered Species are listed on the Federal Permits in recognition of the Conservation Measures and benefits provided for those plants under the BDCP and for the purpose of demonstrating the avoidance of jeopardy pursuant to the Section 7 Biological Opinion. As of the Effective Date, any reference in this Agreement or the BDCP to the authorized take of Covered Species shall, for the purpose of incidental Take authorized under Section 10(a)(1)(B), exclude plant species. To the extent permitted by law, if at any time during the term of this Agreement and the Federal Permits, any plant listed as a Covered Species becomes subject to the take prohibition under the ESA, the Federal Permits shall automatically become effective as to such species, and the Permittees shall receive incidental take authorization for such species.

8.8 Take Authorizations for Rare Plants Covered by the Native Plant Protection Act

CDFW acknowledges and agrees that the BDCP provides sufficient protection to Covered Species that are listed under the NPPA as rare plants for a finding of compliance with the NPPA.

8.9 Take Authorization for Species Covered by the Migratory Bird Treaty Act

The USFWS agrees to issue a Special Purpose Permit under 50 C.F.R. § 21.27 to authorize take of migratory birds protected by the Migratory Bird Treaty Act (MBTA) that are Covered Species and that are also listed under the ESA as threatened or endangered. The Special Purpose Permit will authorize take in the amount specified in the BDCP, subject to the terms and conditions set forth in the Federal Permits.

The Special Purpose Permit will be valid for three years and will be renewed pursuant to the MBTA, provided the Permittees are in compliance with the Federal Permits. Each renewal of the Special Purpose Permit shall be for a period of three years, or longer if the maximum permit term has been extended by law, provided that the Federal Permits remain in effect for such period. If and when any other Covered Species that is protected under the MBTA is designated a Federally Listed Species, the Federal Permits will automatically constitute a Special Purpose Permit for that species as of the date the Federal Permits become effective as to such species.

The Federal Permit will constitute a Special Purpose Permit under the Migratory Bird Treaty Act as provided at 50 C.F.R. § 21.27 for the Take of migratory birds protected by the MBTA that are Covered Species and that are also listed under the ESA as threatened

or endangered, subject to the terms and conditions specified in the Federal Permit, as of the Effective Date. The Special Purpose Permit will be valid for a period of three (3) years from the Effective Date, provided the Federal Permit remains in effect for such period. The Special Purpose Permit will be renewed in accordance with the Migratory Bird Treaty Act provided that the Permittees remain in compliance with the Federal Permit. Each such renewal will be valid for the maximum period allowable under the applicable regulations at the time of the renewal (which, as of the Effective Date is three (3) years), provided that the Federal Permit remains in effect for such period. If and when any other Covered Species that is a migratory bird becomes a Federal Listed Species, the Federal Permit will automatically constitute a Special Purpose Permit for that species as of the date the Federal Permit becomes effective as to such species as provided in this Agreement.

9.0 ACTIVITIES AND ACTIONS COVERED BY THE BDCP

9.1 Introduction

The BDCP is intended to provide the basis for the issuance of regulatory authorizations under the ESA and the NCCPA for a range of ongoing and anticipated activities in the Plan Area. These actions have been designated as either Covered Activities, which encompass those actions that will be undertaken by non-federal parties, or Associated Federal Actions, which refer to those actions that are authorized, funded, or carried out by Reclamation within the Plan Area. Covered Activities and Associated Federal Actions encompass all actions that are proposed for coverage under the Take Authorizations to be issued by the Fish and Wildlife agencies on the basis of the BDCP.

9.2 Covered Activities

The Covered Activities, as described in Chapter 4, consist primarily of activities related to the development and operation of water conveyance infrastructure associated with the SWP that will occur within the Plan Area. Specifically, those SWP-related actions covered by the BDCP involve the following actions:

- The development and operation of new Delta conveyance facilities, in conjunction with the operation of existing facilities, to transport and deliver water to State Water Project and Central Valley Project contractors.

- The maintenance and monitoring of water infrastructure and other facilities.

The Covered Activities also include actions associated with restoration of aquatic and terrestrial habitats, monitoring of Covered Species, and research and study of species and their habitats.

9.3 Associated Federal Actions

The BDCP Associated Federal Actions comprise those activities that are primarily the responsibility of Reclamation, including actions that are carried out, funded, or authorized by Reclamation in the Plan Area, and that would receive appropriate ESA coverage through Section 7. These actions relate to the operation of the CVP's Delta facilities, and conveyance through the SWP's Delta facilities to meet CVP purposes. These actions include the operation of existing CVP Delta facilities to convey and export water for project purposes, associated maintenance and monitoring activities, and the preservation, restoration and creation of habitat. The CVP is operated in coordination with the SWP under the Coordinated Operation Agreement. Associated Federal Actions are described in Chapter 4.

9.4 Integration of the BA and BDCP

The BDCP is a comprehensive plan designed to provide the basis for the biological assessment submitted by Reclamation to support the Section 7 consultation with USFWS and NMFS regarding its CVP-related actions within the Delta. The BDCP Conservation Strategy described in Chapter 3 and the Associated Federal Actions described in Chapter 4 have been incorporated into the biological assessment by Reclamation as its proposed action. The BDCP does not distinguish precisely between the effects on Covered Species and their habitat attributable to the CVP-related federal actions and to Covered Activities associated with the SWP. Rather, the BDCP includes a comprehensive analysis of the effects related to both the SWP and the CVP within the Plan Area, and sets out a Conservation Strategy that adequately addresses the totality of those effects. The incorporation of the BDCP into the biological assessment and subsequent Integrated Biological Opinion ensures comprehensive take authorization for Associated Federal Actions.

9.5 Approval, Adoption or Amendment of Future Plans or Projects by Permittees Inconsistent with the BDCP Objectives and Requirements

The approval, adoption, or amendment of a future plan or project by any Permittee other than the BDCP, that is substantially inconsistent with the objectives and requirements of the BDCP, without the concurrence of the Fish and Wildlife Agencies, is grounds for suspension or revocation of the State Permit. If CDFW determines, after conferring with the Permittees, that such a plan or project has been approved, adopted, or amended in a manner that is substantially inconsistent with the objectives or requirements of the BDCP, CDFW will provide written notice to the Permittees documenting the nature of the inconsistency.

Within fifteen (15) days of the issuance of such notice, CDFW, the Program Manager, and the Permittees shall meet and confer to consider the basis for CDFW's determination

and to identify steps that may be taken to address any such inconsistency. In the event that the inconsistency is not satisfactorily addressed within forty-five (45) days or within a period mutually agreed to by CDFW and the Permittees, CDFW, at its discretion, may suspend or revoke the State Permit, in whole or in part, pursuant to Section 22.4 of this Agreement. CDFW shall not revoke the State Permit until such time as the review process set forth in Section 15.8 of this Agreement has been completed, provided the process has been invoked by a Permittee.

10.0 CONSERVATION STRATEGY

The Conservation Strategy has been designed to achieve the BDCP's overall goals of restoring and protecting ecosystem health, water supply, and water quality in the Delta within a stable regulatory framework. The Conservation Strategy has been developed to meet the regulatory standards of Sections 7 and 10 of the ESA and the NCCPA. The BDCP describes the intended biological outcomes of the Conservation Strategy and details the means by which these outcomes will be achieved. The Conservation Strategy includes biological goals and objectives and conservation actions that appropriately minimize and mitigate the potential effects of Covered Activities and Associated Federal Actions on these resources and provides for the conservation and management of Covered Species and the natural communities upon which they depend. The Conservation Strategy also includes comprehensive programs for adaptive management, monitoring, and research. Additional details regarding the BDCP Conservation Strategy are found in Chapter 3 of the BDCP.

10.1 Biological Goals and Objectives

The biological goals and objectives reflect the ecological outcomes that are expected to occur through the implementation of the BDCP. Biological goals articulate the broad, intended outcomes of the BDCP. Biological objectives are specific, measurable outcomes that are expected to be achieved through the implementation of the Conservation Strategy. The biological goals and objectives are intended to provide the following functions.

- Describe the desired biological outcomes of the Conservation Strategy and how those outcomes will contribute to the long-term conservation of Covered Species and their habitats.

- Provide, where feasible, quantitative targets, metrics, and timeframes for achieving the desired outcomes.

- Serve as benchmarks by which to measure progress toward achieving those outcomes across multiple temporal and spatial scales.

- Provide metrics that will be used to assess the effectiveness of the Conservation Measures and inform decisions regarding potential

adjustments to the Conservation Measures through the adaptive management process.

Through the implementation of the Plan, including adjustments made through the adaptive management process, Permittees will satisfy their obligation to achieve the biological goals and objectives. Unless otherwise specified in the Plan or this Agreement, failure to achieve a biological goal(s) and/or objective(s) shall not be a basis for a determination by the Fish and Wildlife Agencies of non-compliance with the Plan or for the suspension or revocation of the Permits, provided the Permittees are properly implementing the BDCP and are in compliance with this Agreement and the terms and conditions of the Permits.

10.1.1 Relationship to Plan Implementation

Progress toward achieving the biological goals and objectives will be measured during implementation of the Plan through monitoring and targeted research. Biological objectives may be modified over time.

10.1.2 Process to Modify Biological Objectives

Biological objectives may be modified through either the adaptive management decision-making process as described in Chapter 3.6.3.5 and Section 10.3.4 of this Agreement or through the formal amendment process set out in Chapter 6.5.3 and Section 23.3 of this Agreement.

10.2 Conservation Measures

The Parties agree that the implementation of the Conservation Measures will, to the maximum extent practicable, minimize and mitigate impacts to Covered Species and provide for the conservation and management of Covered Species. These measures have been developed in accordance with the principles of conservation biology and address, among other things, ecological processes, environmental gradients, biological diversity, and regional aquatic and terrestrial linkages.

The Conservation Measures are expected to be sufficient to achieve the biological goals and objectives of the Plan during the 50-year timeframe for Plan implementation. Most of the Conservation Measures address several goals and objectives, and most objectives will be met through a combination of Conservation Measures.

The Conservation Measures are described in Chapter 3.4.

10.2.1 Decision Tree Process

10.2.1.1 Purpose and Function

The Parties agree that a key area of scientific uncertainty concerns the volume of Delta outflow that is necessary to advance the biological goals and objectives for both delta smelt and longfin smelt. To address these uncertainties, a "decision tree" process will be established to further investigate the role and contribution of fall and spring outflow for these smelt species. The Decision Tree process is a component of an adaptive management process and is described in CM1. The Parties acknowledge that the outflow requirements associated with the Decision Tree may be met through project operations or other means.

The Decision Tree process describes two potential outcomes for spring outflow and two potential outcomes for fall outflow. The outcomes of the Decision Tree are linked to scientific hypotheses. These hypotheses will be tested over the next approximately ten years using the best available scientific information. The specific outflow requirements for both delta smelt and longfin smelt at the time the new conveyance system becomes operational will be based on the best available science that tests these hypotheses associated with spring and fall outflow.

For permitting purposes, the applicants propose a project with operational and flow criteria intended to achieve the biological goals and objectives, which, among other things, include the range of operational and flow criteria for the high-outflow and low-outflow scenarios. It is expected that USFWS, CDFW, and NMFS will issue Permits for the proposed project, which may include as permit terms and conditions the operational and flow criteria related to the high-outflow scenario in the application.

However, all of the Parties, including USFWS, NMFS, and CDFW, agree that future science and improved information will be used as described herein to determine fall and spring outflow criteria applicable when the conveyance facilities become operational. The relevant Fish and Wildlife Agencies will make the final decision about criteria that will be implemented when the conveyance facilities become operational pursuant to the decision-making process set out in Section 10.2.1.2 and the review process described in Section 15.8.

10.2.1.2 Decision-making Process

The Parties agree that the processes established in Chapter 3.6.3.5, and Section 10.3 and 10.4 for the adaptive management and monitoring program will be used to decide matters regarding the Decision Tree process. The decision tree process will involve the following steps.

1. Clearly articulate scientific hypotheses designed to reduce uncertainty about what outflow criteria are needed to achieve the biological objectives for delta smelt and longfin smelt.

2. Development and implementation of a science plan and data collection and analysis program to test the hypotheses, and report the results of the

analysis as well as the robustness of the results and extent and sources of uncertainty.

3. Completion and peer review of a report that (i) incorporates all pertinent and credible available scientific information including, but not limited to, the data, analyses, and results that emerge from the above investigations, (ii) includes a critical assessment and synthesis of such scientific information, and (iii) interprets such scientific information in order to identify a recommended course of action with respect to the alternatives set out through the decision tree process. This step will be administered by the Implementation Office under the direction of the Adaptive Management Team.

4. Prior to the time CM1 operations begin, the Implementation Office will provide the report (including the Adaptive Management Team's recommendation) to the Authorized Entity Group and the Permit Oversight Group for decision pursuant to Chapter 3.6.3.5.3, and Sections 10.3 and 10.4.

10.2.1.3 No Requirement for Plan or Permit Amendment

The Permits and related Section 7 consultation processes will be used to authorize Take associated with Covered Activities and Associated Federal Actions based in part on specific outflow criteria. Neither the BDCP nor the associated regulatory authorizations would need to be amended to allow for the implementation of flow criteria determined through the Decision Tree process.

10.2.1.4 Relationship of Decision Tree Process to the Adaptive Management Program

The Parties acknowledge that changes to CM1 may occur through the adaptive management program, which will go into effect once the BDCP has been permitted. Notwithstanding the foregoing, with respect to changes to CM1 related to outflow requirements for delta and longfin smelt pursuant to the Decision Tree process, such changes may not occur through the adaptive management program until the Authorized Entity Group and Permit Oversight Group act on the recommendation as set out in the Decision Tree report. The outflow criteria applicable to CM 1 may be within the range of outflow criteria analyzed in the decision tree and will be based on the best available science.

10.2.1.5 Relationship of the Decision Tree Process to Other Covered Fish Species

The Parties recognize that other covered fish species, including salmonids and sturgeon, are affected by outflow. As such, the Parties understand that NMFS and CDFW will

consider outflow needs for other Covered Species as part of their review of the Plan. The outflow needs of these species will also be investigated as part of the scientific research and analysis that will be conducted prior to the new conveyance system becoming operational. In the event that information developed during this period indicates that changes to the outflow requirements of CM1 associated with these other fish species are warranted, adjustment will occur in the context of the adaptive management program.

10.2.2 Real Time Adjustments to Water Operations

10.2.2.1 Purpose and Function

The Parties shall establish a "real time operations" mechanism to allow for short-term adjustments to be made to water operations, within the established ranges and criteria as set out in CM1 and CM2, for the purpose of maximizing conservation benefits to covered fish species and maximizing water supplies.

The Parties agree that any real time operational adjustments shall be made in accordance with the following guidelines:

- The primary BDCP agencies (CDFW, USFWS, NMFS, DWR, and Reclamation) will collaborate in making real time operational adjustments.

- The scope of real time operational adjustments will apply only to certain identified operational parameters and will occur within the boundaries of, or consistent with, the operational criteria set out in CM1 and CM2.

- Real time adjustments that are anticipated to be implemented in the coming year will be identified in the Annual Delta Water Operations Plan developed by DWR and Reclamation with input from the RTO Team. The Annual Delta Water Operations Plan will also describe how project reoperations and the Supplemental Resources Fund assets will be used as part of real time operations for the purpose of maximizing conservation benefits to covered fish species and maximizing water supplies.

10.2.2.2 Real Time Operations Process

10.2.2.2.1 Real Time Operations Team

The Parties shall establish a Real Time Operations Team ("RTO Team"), which will consist of one representative each from USFWS, NMFS, CDFW, Reclamation, and DWR. The RTO Team will also include one representative of the SWP Contractors and one representative of the CVP Contractors, who will serve as non-voting members. The voting members may, by consensus, expand the membership of the RTO Team.

10.2.2.2.2 Function of the RTO Team

The RTO Team will track and document real time operational adjustments as they are implemented in relation to what was identified in the Annual Delta Water Operations Plan and assess the effect of such adjustments on Covered Species and quantify the effects on water supply. The RTO Team will also document use of the Supplemental Resources Fund as part of real time operations. Documentation of any adjustment that was made to operations, and the effect, if any, of the adjustment on water supply, will include information regarding the circumstances that warranted an adjustment and the expected benefits to the targeted Covered Species and to water supply. The RTO Team shall make such information available to the public through a website or other electronic medium. This information will be used by DWR and Reclamation in the development of subsequent Annual Delta Water Operations Plans. This subsection describes the operations planning expected to occur on an annual basis for the purpose of maximizing conservation benefits to covered fish species and maximizing annual water supplies.

10.2.2.2.3 Decision-Making Process

The RTO Team shall operate by consensus when making recommendations related to real time adjustments to water operations. In the event that consensus cannot be reached among the RTO Team, the matter will be elevated to the director of CDFW and the regional director of the relevant federal Fish and Wildlife Agency and the director of DWR and the regional director of Reclamation. Absent the concurrence of the relevant agency directors, the disputed real time operational adjustment will not be made.

10.2.2.3 Scope of Real Time Operational Adjustments

The Parties recognize and agree that any such operational adjustments effectuated through the real time process shall be limited to the specific parameters and criteria set out in Chapter 3.4.1.4 and shall apply only to those facilities and activities identified in CM1 and CM2. Some operational parameters will not be subject to real time adjustments, as these components of the system would be operated pursuant to discrete criteria set out in the Conservation Measure.

Facilities that will be subject to real time operational adjustments are as follows:

- North Delta Intakes (CM1)
- Delta Cross Channel Gates (CM1)
- Head of Old River Gate (CM1)
- South Delta Diversions (Clifton Court and Jones Pumping Plant) (CM1)
- Fremont Weir Operable Gates (CM2)

The extent to which real time adjustments that may be made to each parameter related to these facilities shall be limited by the criteria and/or ranges set out in CM1 and CM2. That is, operational adjustments shall be consistent with the criteria, and within any ranges, established in the Conservation Measures.

Any modifications to the parameters subject to real time operational adjustments or to the criteria and/or ranges set out in CM1 or CM2 shall occur only through the adaptive management program or by Plan amendment. Similarly, any changes to the facilities or activities subject to real time operational adjustments shall occur only through the adaptive management program or by Plan amendment.

10.2.3 Process to Modify Conservation Measures

Conservation measures may be modified solely through the adaptive management decision-making process as described in Chapter 3.6.3 and Section 10.3.4 of this Agreement or, if necessary, through the formal amendment process set out in Chapter 6.5.3 and Section 23.3 of this Agreement.

10.3 Adaptive Management Program

10.3.1 Purpose

Under the adaptive management and monitoring programs, new information and insight gained during the course of Plan implementation will be used to develop and potentially implement alternative strategies to achieve the biological goals and objectives. Monitoring and research will be used, among other things, to confirm Plan implementation and to measure the efficacy of the Conservation Measures, factors affecting the response of the ecosystem and Covered Species to these measures, and the influence of factors present outside the Plan Area.

The Parties recognize that the some of the Conservation Measures may not achieve their expected outcomes, while others may produce better results than expected. Through monitoring and research efforts, new scientific data, information, and analysis, the Parties will be informed regarding the capacity of the Conservation Measures to meet the biological goals and objectives. The adaptive management program will afford the flexibility to allow for changes to be made to Conservation Measures and biological objectives, including the addition to or elimination of such measures or objectives, to improve the effectiveness of the Plan over time.

10.3.2 Adaptive Management Team

10.3.2.1 Purpose and Function

An Adaptive Management Team shall be established as set forth in Chapter 3.6.2.2. The Adaptive Management Team shall have primary responsibility for administration of the adaptive management and monitoring program and shall have the authority to make decisions involving certain specified matters; for certain other matters, the role of the Adaptive Management Team will be to develop and make recommendations regarding potential adaptive changes for consideration by the Authorized Entity Group and the

Permit Oversight Group; and for other matters, the Adaptive Management Team will serve as a source of guidance and advice to the Implementation Office.

10.3.2.2 Membership and Composition

The Adaptive Management Team shall be chaired by the Science Manager and shall consist of representatives of DWR, Reclamation, two participating State and federal water contractors (one each representing the SWP and CVP), CDFW, USFWS, and NMFS. Each of the foregoing parties shall be voting members. The Lead Scientist for the Interagency Ecological Program, the Lead Scientist for the Delta Science Program and the Director of the NOAA Southwest Fisheries Science Center shall also be members of the Adaptive Management Team, but shall serve in an advisory capacity only and shall not be eligible to vote on matters. The directors of DWR and CDFW and the regional directors of Reclamation, USFWS, and NMFS will each designate a management-level representative to serve on the Adaptive Management Team, each of whom shall be qualified to represent both policy and scientific perspectives on behalf of their respective agencies.

10.3.2.3 Meetings of the Adaptive Management Team

The Adaptive Management Team shall determine its meeting schedule and administrative matters. The Implementation Office shall ensure that a record of Adaptive Management Team meetings and its actions is posted to a website or other appropriate electronic medium to ensure public access. The record should include a list of meeting attendees, meeting agenda, decisions and/or recommendations made, assignments to conduct additional work on a matter, audiovisual presentations or other materials distributed, and other documents relevant to the deliberations of the Adaptive Management Team.

On a periodic basis, the Adaptive Management Team shall open its meetings to the public. The Adaptive Management Team will institute procedures with respect to public notice of and access to these meetings. The date, time, and location of the meetings will be posted on the BDCP website at least ten (10) days prior to such meetings. The meetings will be held at locations within the City of Sacramento or the legal Delta.

10.3.3 Adaptive Management Changes Involving Routine or Administrative Matters

10.3.3.1 Scope of Routine and Administrative Matters

The Adaptive Management Team shall make decisions involving routine scientific matters associated with adaptive management, effectiveness monitoring, and research activities. The Adaptive Management Team shall also make decisions regarding administrative matters involving the Adaptive Management and Monitoring Program. These matters have been specifically assigned to the Adaptive Management Team in Chapter 3.6. They include: reassessment of and modifications to problem statements and

conceptual models; synthesis of scientific information; preparation and distribution of information pertaining to adaptive management, effectiveness monitoring, and scientific research to various parties, including policy-makers, stakeholders, and the public.

10.3.3.2 Development of Proposals regarding Routine or Administrative Matters

On a periodic basis or otherwise as appropriate, the Adaptive Management Team will consider, based on biological monitoring data and other information available at the time, whether conditions warrant a routine or administrative change to the Adaptive Management and Monitoring Program. As part of its deliberations, the Adaptive Management Team may seek input from independent scientists or from other appropriate sources, including the Technical Facilitation Sub-group of the Stakeholder Council. In the event that the Adaptive Management Team determines that a routine adaptive management change may be warranted, it may develop a proposal for the change. The Authorized Entities, the Fish and Wildlife Agencies, or the Stakeholder Council also may submit for consideration by the Adaptive Management Team, through the Science Manager, proposals for such adaptive changes. The Adaptive Management Team may receive proposals from other interested parties and, at its discretion, may review any such proposals and determine whether such proposals will receive further consideration.

In its consideration of issues and development of recommendations the Adaptive Management Team will identify relevant policy, legal, and regulatory principles and will make decisions regarding routine or administrative matters consistent with the schedule, budget and the adaptive resources available to support the Adaptive Management and Monitoring Program. The Science Manager will work with the Program Manager to define the policy, legal, budget or schedule issues at hand and will provide such information to the Adaptive Management Team prior to any action on the matter. The Adaptive Management Team will consider technical input that may be received from the Technical Facilitation Subgroup of the Stakeholder Council, as described in Chapter 7.1.6.

10.3.4 Adaptive Management Changes to Conservation Measures or Biological Objectives

The Adaptive Management Team shall be responsible for developing proposals for changes to the Conservation Measures and to the biological objectives for consideration by the Authorized Entity Group and the Permit Oversight Group. On a periodic basis or otherwise as appropriate, the Adaptive Management Team will consider, based on biological monitoring data and other information available at the time, whether conditions warrant a change to a Conservation Measure or a biological objective. As part of its deliberations, the Adaptive Management Team may seek input from independent scientists or from other appropriate sources, including the Technical Facilitation Sub-group of the Stakeholder Council. In the event that the Adaptive Management Team determines that a change in a Conservation Measure or a biological objective may be

warranted, it may develop a proposal for a change. The Authorized Entities, the Fish and Wildlife Agencies, and the Stakeholder Council may submit to the Adaptive Management Team, through the Science Manager, proposals for a change to a Conservation Measure or biological objective, and such proposals shall be considered by the Adaptive Management Team. The Adaptive Management Team may also receive proposals for adaptive changes from other interested parties and, at its discretion, review any such proposals to determine whether such proposals will receive further consideration.

In its consideration of issues and development of recommendations the Adaptive Management Team shall take into account the policy, legal, and regulatory principles that may be relevant to the proposed change to a Conservation Measure or a biological objective and shall make its recommendations consistent with the adaptive resources available under the Plan, as set forth in Section 10.3.7. The Science Manager will work with the Program Manager to define policy, legal, budget, schedule and adaptive resource issues and will provide such information to the Adaptive Management Team prior to any action on the matter. The Adaptive Management Team shall review relevant data and information, and take into account any input from the Authorized Entity Group, the Permit Oversight Group, or the Stakeholder Council, including technical input that may be received from the Technical Facilitation Subgroup of the Stakeholder Council.

Adaptive management actions that are associated with the implementation of the Conservation Measures and are within the scope of the Conservation Measures as described in the Plan will be determined and undertaken by the Implementation Office. Such actions shall not be subject to the processes set out in Section 10.3 and will not require the approval or concurrence of the Authorized Entities, the Fish and Wildlife Agencies, or the Adaptive Management Team.

10.3.5 Decision-making Process

The decision-making process set out in this Section shall be used to effectuate changes to elements of the Adaptive Management and Monitoring Program, including those that are considered to be "routine" or that involve changes to the administration of the Adaptive Management and Monitoring Program, and to the Plan's Conservation Measures or biological objectives.

10.3.5.1 Decision-Making Process

10.3.5.1.1 Routine or Administrative Matters

In the event that the Adaptive Management Team achieves consensus as to whether adopt a routine or administrative change, the decision on the matter shall be considered final. Such decisions of the Adaptive Management Team shall not be subject to review and consideration by the Authorized Entity Group and the Permit Oversight Group, nor shall they be subject to the review process established in Section 15.8 of this Agreement.

In the event that the Adaptive Management Team fails to reach consensus regarding a proposed routine or administrative change, the Adaptive Management Team will document for the Authorized Entity Group and the Permit Oversight Group the change under consideration and the nature of the disagreement, including the divergent positions taken by the voting members of the Adaptive Management Team. The Program Manager will forward the documentation to the Authorized Entity Group and the Permit Oversight Group for their consideration. The Program Manager may supplement the documentation prepared by the Adaptive Management Team with any information the Program Manager believes will assist the Authorized Entity Group and Permit Oversight Group in reaching a determination on the matter. Resolution of the issue in dispute will follow the process set out below pertaining to changes to Conservation Measures or biological objectives; however, with respect to potential routine or administrative changes, if the Authorized Entity Group and Permit Oversight Group are unable to reach agreement, the Permit Oversight Group will decide the matter.

The Program Manager shall be responsible for documenting any routine or administrative changes that are adopted. Such information will be included in the Annual Progress Report, as described in Chapter 6.3.3.

10.3.5.1.2 Matters Involving Potential Changes to Conservation Measures or Biological Objectives

With respect to its consideration of a proposed change to a Conservation Measure or a biological objective, the Adaptive Management Team may or may not reach consensus regarding the matter. In either event, the Adaptive Management Team, upon completing its consideration of the proposed change, shall promptly notify the Authorized Entity Group and the Permit Oversight Group of the outcome of its deliberations.

As part of its notification, the Adaptive Management Team shall include information to assist the Authorized Entity Group and the Permit Oversight Group in their consideration of the proposed change. Specifically, the Adaptive Management Team shall provide the Authorized Entity Group and the Permit Oversight Group with the following information:

- A description of the proposed change, including, as applicable, the extent, magnitude, and timing of the proposed modification.

- A description of the scientific rationale for the proposed change and why it is reasonably expected to better achieve the biological objectives (if the change is to a Conservation Measure) or goals (if the change is to an objective) of the Plan.

- Identification of any alternatives that were considered and the reasons for their rejection.

- A description of any uncertainties associated with the change and potential approaches to reducing any such uncertainties.

- A report describing any information derived from independent science review and an explanation of how that information was addressed in the recommendation.

- An analysis of the potential cost in water, land, money, or other resources associated with the change being proposed.

- An analysis of the means by which the adaptive resources available to support adaptive management actions will be used to fund the proposed change, if applicable.

- A cover letter and any information the Program Manager believes may be helpful in assisting the Authorized Entity Group and Permit Oversight Group in making their decision.

If the Adaptive Management Team has not reached consensus on the recommendation, it will forward to the Program Manager the proposals, each prepared by a member or group of members within the team, which represents the differing views of how the matter should be resolved.

The Authorized Entity Group and the Permit Oversight Group will jointly meet to consider and act on the matter presented by the Adaptive Management Team. In the process of its deliberations, the Authorized Entity Group and Permit Oversight Group may jointly meet and confer with the Adaptive Management Team to discuss the matter at hand. The Authorized Entity Group and the Permit Oversight Group shall decide matters taking into account the policy, legal, and regulatory principles, as set forth below, as well as budgetary and scheduling considerations and the parameters established for the adaptive resources available to support the change under consideration. The Authorized Entity Group and Permit Oversight Group may base their decision on the information provided by the Adaptive Management Team and the Program Manager, or they may gather additional information or commission independent expert review to further inform their decision.

Any member of the Authorized Entity Group or Permit Oversight Group may introduce supplemental information not provided by the Adaptive Management Team or the Program Manager for the purpose of better informing deliberations. The member may further seek independent expert review of the supplemental information. With regard to such information, if any member should so request, it will be provided to the Adaptive Management Team for its review and comment. The Adaptive Management Team may comment on the information either through a report reflecting the consensus of its members or, in the event no such consensus is reached, through individual comments.

As part of their deliberations on changes to Conservation Measures, the Authorized Entity Group and the Permit Oversight Group shall take into account the following legal, policy, and regulatory principles:

- The scope and nature of a proposed adaptive response will be considered within the totality of the circumstances, including the degree to which the change is reasonably expected to offset the impacts of Covered Activities or Associated Federal Actions and Plan implementation or to better achieve the biological objectives.

- The proposed adaptive management action must be consistent with the legal authority of the entity responsible for effectuating the action.

- The Adaptive Management process will be used to help ensure that Conservation Measures are in conformity with the ESA and NCCPA permit issuance criteria throughout the course of Plan implementation. Changes will be limited to those actions reasonably likely to ensure that (1) the impacts (or levels of impacts) of a Covered Activity or Associated Federal Action on Covered Species that were not previously considered or known are adequately addressed or (2) a Conservation Measure or suite of Conservation Measures that are less than effective, particularly with respect to effectiveness at advancing the biological goals and objectives, are modified, replaced or supplemented to produce the expected biological benefit.

- The strength of the scientific evidence linking the proposed change to a Conservation Measure and to the ability of the Plan to achieve the relevant biological objective or objectives.

- An assessment will be made of a potential adaptive change so that the desired outcome(s) will be achieved with the least resource costs. As long as equal or greater biological benefits can be achieved, adaptive responses should favor changes that minimize impacts to water supply or reliability.

- Prior to any decision to change a Conservation Measure in a manner that would potentially result in the modification of water supplies consistent with Section 9.3.7, non-operational alternatives will be considered and, if such alternatives are rejected, the Adaptive Management Team will provide an explanation provided as to why they were not sufficient to address the effects of the Covered Activity, or Associated Federal Action, or achieve the biological objective(s) of the Plan.

If the Authorized Entity Group and the Permit Oversight Group jointly agree that the proposed change to a Conservation Measure or biological objective is warranted, the change will be adopted and incorporated into the Plan.

In the event that the Authorized Entity Group and the Permit Oversight Group are unable to reach agreement on the proposed change to a Conservation Measure or biological objective, the dispute review process described in Chapter 7.1.7 and Section 15.8 of this Agreement will be available to the Parties. If invoked, the appropriate Fish and Wildlife Agency official with authority over the matter, after considering the available information and taking into account the advice of the review panel, shall decide whether the proposed change, or an alternative to the proposed change, will be adopted.

The Program Manager shall be responsible for documenting any changes made to the Conservation Measures or the biological objectives. Such information will be included in the Annual Progress Report, as described in Chapter 6.3.3.

10.3.6 No Requirement for Plan or Permit Amendment

The Parties recognize and agree that a change to a Conservation Measure or to a biological objective shall not require an amendment to the BDCP nor to the regulatory authorizations issued pursuant to the Plan, provided such change is adopted through the adaptive management process, as described in this Section, and in a manner consistent with the adaptive resources available for such changes, as described in Section 10.3.7 and Chapter 3.4.

10.3.7 Resources to Support Adaptive Management

10.3.7.1 Resources Generally Available to Support Changes in Conservation Measures

Pursuant to the adaptive management process described in Section 10.3.4, the Parties may modify or adjust Conservation Measures and biological objectives. Such changes to Conservation Measures include the following strategies: modifying approaches to the implementation of the measures, shifting resources from less effective to more effective Conservation Measures, adding and/or eliminating Conservation Measures, and using the Supplemental Adaptive Management Fund to fund, if necessary, any such changes to the Conservation Measures.

The Parties agree that any potential adaptive management changes to the Conservation Measures, either individually or cumulatively, shall not require the commitment of resources, including land, water, or money, in excess of those specifically provided for under these strategies, including the Supplemental Adaptive Management Fund, or alter the financial commitments of the Plan participants, as set out in Chapter 8.

10.3.7.2 Resources Available to Support Changes to Water Operations Conservation Measures

In the event that changes to CM1 are adopted through the adaptive management process, the resources necessary to implement such changes shall be drawn from the following sources, to the extent available, and in the order of priority set out below.

- Adjusting operations on an inter-annual basis.
- Sharing resources derived from water supply improvements.
- Re-allocating resources from less effective Conservation Measures.
- Drawing funds from the Supplemental Adaptive Management Fund.

The limits and constraints associated with each of the foregoing sources are set out in Chapter 3.4 and Chapter 8. Any such changes to CM1 shall be consistent with the funding commitments set out in those chapters.

10.3.7.3 The Supplemental Adaptive Management Fund

10.3.7.3.1 Purpose

A Supplemental Adaptive Management Fund, as described in Chapter 3.4.23.5, shall be established to support adaptive management changes to CM1, as well as to other Conservation Measures, determined to be necessary during Plan implementation. The Fund will be made available to support an adaptive management change in the event that sufficient resources cannot be secured through the first three of the approaches identified in Section 10.3.7.2. Funding for the Supplemental Adaptive Management Fund will be as described in Chapter 8 of the Plan and Section 13.1 of this Agreement.

10.3.7.3.2 Availability of the Fund

The Parties agree that the funds within the Supplemental Adaptive Management Fund shall be made available pursuant to the process and criteria set out in the Plan and this Section to support adaptive management changes to any of the Conservation Measures. Prior to any such use of the Supplemental Adaptive Management Fund, the parties shall determine whether sufficient resources to support an adaptive change are available from any of the sources identified in Section 9.3.3.2, subject to the limitations associated with each. If a determination is made that adequate funds are not available through these sources, the Supplemental Adaptive Management Fund may be used at any time, provided the following actions have occurred or determination shave been made beforehand.

- A 5-year periodic review has determined that one or more of the biological objectives are unlikely to be achieved through the implementation of the existing Conservation Measures.

- The biological objectives have been assessed to determine their likely achievability through the implementation of the Plan and, adjustments were made on the basis of new circumstances and scientific information.

- A lack of progress toward achieving one or more biological objectives is related to or caused by the Covered Activities or Conservation Measures.

- Adjustments to one or more Conservation Measures (e.g., more flow, changes in habitat restoration targets or locations) are likely to address the problem.

- To the extent appropriate, existing assets have been reallocated to support adequate changes to Conservation Measures (Chapter 3.4.23.3, *Redirected Funding to the Most Effective Conservation Measures*).

- Measures that do not adversely affect water supply, if any, have been implemented.

If the consideration of the foregoing factors confirms the need to use the fund, the Implementation Office, pursuant to the direction provided through the adaptive management process, would initiate actions to deploy the money available through the Supplemental Adaptive Management Fund to provide the additional resources necessary to implement the adaptive management change. The parties anticipate that such funds could be used to acquire water to supplement flows, undertake additional natural community restoration, or implement a range of other actions. In the event that additional outflow was determined to be necessary, supplemental water may be acquired from voluntary sellers. In the event that additional natural community restoration actions or investment in predation reduction activities were determined to be necessary, these actions may also be funded through the Supplemental Adaptive Management Fund.

10.3.7.3.3 Relationship to Regulatory Assurances and Protections

The resources provided for under the Supplemental Adaptive Management Fund, as well as other resources that may be available through actions described in Section 9.3.7.2, reflect the full extent of the commitment of the Parties to support changes made to the Plan through the adaptive management process. These commitments shall be considered part of the overall resource obligations of the Parties in the context of the regulatory Assurances and Protections described in Section 14.0.

10.4 Biological Monitoring and Research

Biological monitoring and research shall be conducted to provide new data and information regarding ecological and scientific matters relevant to the BDCP pursuant to Chapter 3.6. The data and information gathered through these and other efforts will be

used to inform key decisions, including those involving adaptive management actions, and to assess progress toward meeting the Plan's biological goals and objectives.

10.4.1 Scope of Biological Monitoring

The purpose of the biological monitoring program is to provide the necessary data, information, and analysis to determine the effect of the Plan on Covered Species and their habitats and to assess the effectiveness of the Plan in advancing the biological goals and objectives. Specifically, "effects" monitoring will provide the basis for evaluating the impacts of Covered Activities, Associated Federal Actions, and Conservation Measures on Covered Species, including the amount of take of Covered Species; "effectiveness" monitoring will provide the basis for determining the effectiveness of the Conservation Measures and identifying the need for adaptive management responses, as described in Chapter 3.6.4.4.

Effectiveness monitoring actions are identified in the descriptions of each Conservation Measure identified in Chapter 3.4, and listed by Conservation Measure in Table 3.E-2 of Appendix 3.E of the Plan. Metrics and protocols for effectiveness monitoring will be developed, under the direction of the Adaptive Management Team, at the early stages of Plan implementation and will be periodically revised to reflect new scientific developments and improved technological capability.

10.4.2 Responsibility of Adaptive Management Team

The Adaptive Management Team shall have primary responsibility for the overall development and administration of the monitoring and research program, as described in Chapter 3.6.2.2. The Adaptive Management Team will also be responsible for integrating the adaptive management and monitoring activities into one cohesive program.

10.4.3 Annual Monitoring and Research Plan

The Implementation Office shall prepare an Annual Monitoring and Research Plan, based on the recommendations and guidance provided by the Adaptive Management Team. The plan will identify, among other things, the type, scope, nature and timing of the proposed monitoring and research activities and the rationale and need for such activities, as further described in Chapter 3.6.4.

A draft of the Annual Monitoring and Research Plan will be submitted to Authorized Entity Group and the Permit Oversight Group for their joint approval. In the event that the Authorized Entity Group and the Permit Oversight Group are unable to reach agreement on the Annual Monitoring and Research Plan, the Permit Oversight Group will determine whether the proposed plan, or an alternative to that plan, will be adopted. If a member(s) of the Authorized Entity Group does not agree with the decision of the Permit

Oversight Group, the dispute will be resolved pursuant to the review process described in Chapter 7.1.7.

The Implementation Office will incorporate the Annual Monitoring and Research Plan into the Annual Work Plan and Budget, as described in Chapter 6.3.1.

10.4.4 Role of Independent Science

The Adaptive Management Team may direct scientific reviews and solicit independent scientific advice to assist the team in its management of the monitoring and research program. The Adaptive Management Team, through the Science Manager, will coordinate monitoring and research efforts with the Delta Science Program, the IEP, the Authorized Entity Group, the Permit Oversight Group, and the Stakeholder Council.

11.0 PLAN IMPLEMENTATION

11.1 Implementation Schedule

The Implementation Office will ensure that the Conservation Measures are implemented substantially in accordance with the Implementation Schedule, Exhibit D. The Parties agree that implementation of the Conservation Measures in accordance with the Implementation Schedule will help ensure that the impacts of Covered Activities and Associated Federal Actions on Covered Species are minimized and mitigated, to the maximum extent practicable, and that the measures are sufficient to provide for the conservation and management of Covered Species.

11.1.1 Maintaining Rough Proportionality Between Impacts and Conservation Measures

If the Conservation Measures are implemented in accordance with the Implementation Schedule and procedure as detailed in Chapter 6.1.2 and Tables 6-1 and 6-2 of the Plan, Rough Proportionality will be considered by CDFW to be maintained in accordance with the NCCPA.

11.1.2 Procedure for Addressing Failure to Maintain Rough Proportionality

If a Fish and Wildlife Agency determines that Rough Proportionality between impacts to Covered Species and the implementation of the Conservation Measures is not being maintained, that agency will invoke the following process. If a Fish and Wildlife Agency determines, after conferring with the Implementation Office, that the conditions of the Implementation Schedule are not being met, the Fish and Wildlife Agencies, the Program Manager, and the Permittees shall meet and confer. Within forty-five (45) days of the determination, the Permittees shall either (a) regain Rough Proportionality by demonstrating substantial implementation of the actions according to the existing

Conservation Strategy and Implementation Schedule; or (b) enter into an agreement with the relevant Fish and Wildlife Agency(ies) to expeditiously regain Rough Proportionality. Such an agreement may include advancing and/or accelerating plans to acquire, restore, or enhance lands of the appropriate land cover type.

If the Implementation Office has not re-established Rough Proportionality within forty-five (45) days or has not entered into and maintained compliance with an agreement with the Fish and Wildlife Agency(ies) within that period that sets a course of action to regain Rough Proportionality in a timely manner, the Fish and Wildlife Agency(ies) may suspend or revoke their Permits, in whole or in part. The partial suspension or revocation may include removal of one or more Covered Species or reduction in the scope of the Take Authorizations. The Fish and Wildlife Agency(ies) may suspend but shall not revoke the Permits until such time as the review process set forth in Section 15.8 of this Agreement has been completed, provided the process has been invoked by a Permittee.

11.2 Advance Credit for Interim Implementation Actions

Implementation actions that have been undertaken or completed prior to the issuance of the Permits, but after the date of execution of the Planning Agreement in October 2006, will be credited toward meeting the overall BDCP conservation requirements, provided that the actions (1) are consistent with the Conservation Measures; (2) advance the BDCP's biological goals and objectives; and (3) do not constitute mitigation associated with projects that are not a Covered Activity or Associated Federal Action.

Interim implementation actions that may meet the three aforementioned conditions include those listed in Table 6-4 of the Plan. These actions may be credited toward the fulfillment of the Conservation Measures set out in Chapter 3, after evaluation by the Fish and Wildlife Agencies.

11.3 Credit for Restoration Actions Identified in the CVP/SWP Long-Term Operation Biological Opinions and State Incidental Take Permit

Notwithstanding the provisions of Section 11.2 above, the Parties agree that 8,000 acres of tidal habitat restoration identified in the USFWS Biological Opinion (issued December 15, 2008) and the CDFW Consistency Determination (issued October 14, 2011), and further discussed in the NMFS Biological Opinion (issued June 4, 2009) and the CDFW Consistency Determination (issued April 27, 2012) and in the Section 2081 permit issued for longfin smelt (issued February 23, 2009), will be credited to the BDCP as restoration actions fulfilling a portion of the obligations identified in Conservation Measure 4 once the required criteria have been met.

11.4 Reserve System

The creation and management of the Reserve System is a component of the Conservation Strategy, as described in Conservation Measure 3 in Chapter 3.4.3. The Implementation Office shall oversee the creation of the Reserve System, which will consist of a number of individual reserve units. The Reserve System will be created through the permanent protection and long-term management of aquatic and terrestrial habitats.

11.4.1 Provisions to Ensure Long-Term Protection of Reserve System Lands

Reserve System lands shall be permanently protected through acquisition of fee title or conservation easement, or, where there is an identified impediment to transferring fee title or creating a conservation easement, through the use of another site protection mechanism approved by the Fish and Wildlife Agencies. All Reserve System conservation easements will comply with California Civil Code sections 815–816 and California Government Code, section 65965 *et seq*. Conservation easement templates for natural lands and for agricultural lands will be developed by the Authorized Entities and will be subject to the approval of the Fish and Wildlife Agencies. Upon approval by the Fish and Wildlife Agencies, those templates will be deemed to be attachments to this Agreement as Exhibit E for natural lands and Exhibit F for agricultural lands. The easement templates may be revised, subject to approval of the Fish and Wildlife Agencies, without amendment to this Agreement.

The Fish and Wildlife Agencies shall designate which template provisions are to be required in each easement, unless otherwise approved by the Fish and Wildlife Agencies, and which provisions can be amended in individual easements without the further approval of the Fish and Wildlife Agencies. In cases requiring approval of an easement template revision, or a revision to a particular easement, the Implementation Office shall seek and obtain the approval of the applicable Fish and Wildlife Agencies. The Fish and Wildlife Agency(ies) requested to approve a revision to the easement template, or to approve an easement revision specific to a particular parcel of land, shall respond to the Implementation Office within sixty (60) days.

The Implementation Office will ensure that non-wasting endowments, or substantial equivalent as approved by the Fish and Wildlife Agencies, are established for Reserve System lands to ensure funding for long-term management in perpetuity.

The Implementation Office shall carry out the reserve management responsibilities, as further described in Chapter 3.4.11 of the Plan. The Implementation Office may delegate planning and implementation tasks to other Parties or qualified third parties, including but not limited to universities, scientists and other contractors. However, the Permittees shall remain solely responsible for ensuring the management of the reserve lands and the timeliness and quality of all requirements of reserve management during the term of the Permits and ensuring mechanisms are in place for reserve management in perpetuity.

Where the Authorized Entities have funded an endowment to fully satisfy certain conservation obligations under the Plan and the endowment has been reviewed and approved in writing as adequate by the Fish and Wildlife Agencies, funding is deemed adequate to carry out such obligations, and the Fish and Wildlife Agencies shall not require additional funds or resources from the Authorized Entities with regard to those obligations.

11.4.2 Reserve Management Plans

11.4.2.1 Reserve Unit Management Plans

The Implementation Office will prepare and implement management plans for protected natural communities and Covered Species habitats that are found within those communities. Management plans will be prepared by reserve unit, which may be an individual reserve or multiple reserves in a specified geographic area that share common management needs. Within two years of acquiring parcels, the Implementation Office will conduct surveys to collect information to identify actions necessary to achieve the applicable biological objectives related to management and enhancement of the reserve. The Implementation Office will prepare reserve unit management plans in collaboration with the Fish and Wildlife Agencies, and will submit plans to the Fish and Wildlife Agencies for approval within four years of the first acquisition within each reserve unit. Prior to approval of a reserve unit management plan, reserves will be managed using best practices based on successful management of the site prior to acquisition, or based on management at other similar sites.

General enhancement and management actions to be implemented throughout the reserve system are described in Chapter 3.4.11.2.3 and address fire management, recreation, invasive plant control, nonnative animal control, mosquito abatement, pesticides, levee maintenance, reserve system connectivity and permeability, and access control. Management and enhancement actions specific to certain natural communities will be included in reserve management plans, as provided in CM 11.

The Implementation Office shall evaluate each Reserve Management Plan for effectiveness and revise it as appropriate (a) to incorporate new acquisitions within the same reserve unit and to document new best management practices; (b) at least every five (5) years to ensure that the BDCP adaptive management and monitoring program and the results of the latest research are being applied to management in each reserve unit, and (c) whenever necessary under Changed Circumstances pursuant to Section 12.0 of this Agreement.

11.4.2.2 Management of Agriculture and Grazing Easements or Leases

Reserve unit management plans for cultivated lands, grasslands or other natural communities may include ongoing grazing or agricultural activities, if approved by the

Fish and Wildlife Agencies, pursuant to Conservation Measure 11, Chapter 3.4.11.2.7. For reserve units that are acquired through fee title, the Implementation Office shall include the terms of the reserve unit management plan in any lease or other agreement that allows continued grazing or other agricultural use of the land. For lands that are acquired through conservation easement, any key elements related to maintaining or enhancing habitat for Covered Species (i.e., essential requirements, restrictions or other criteria required for the reserve unit management plan) shall be included or referenced in the conservation easement. The reserve unit management plan itself shall be completed within two (2) years after recording the conservation easement.

12.0 CHANGED CIRCUMSTANCES

Ecological conditions in the Delta are likely to change as a result of future events and circumstances that may occur during the course of the implementation of the BDCP. The BDCP identifies changes in circumstances that are reasonably foreseeable and that could adversely affect reserve system lands or waters in the Plan Area, consistent with the "changed circumstances" provisions of the ESA regulations and in the NCCPA. To ensure successful implementation of the Conservation Strategy, the BDCP sets out measures designed to respond to these foreseeable future changes.

The BDCP identifies the specific Changed Circumstances that can reasonably be expected to occur in the Plan Area during the course of Plan implementation and that may compromise the effectiveness of the implementation actions set out in the BDCP. As set out in Chapter 6.4.2, the Plan describes the responses that will be implemented through the BDCP to adequately address such events and discusses their potential to prevent or impede the BDCP from achieving anticipated biological outcomes. The specific approaches and steps related to many of the planned responses will be developed and implemented through the adaptive management program (Chapter 3.6). However, for certain Changed Circumstances, responsive actions will fall outside the scope of the adaptive management program; these actions are specifically described in Chapter 6.4.2. The planned responses to Changed Circumstances have been designed to be practicable yet sufficient to effectively address such events.

12.1 Process to Respond to Changed Circumstances

The Implementation Office and the Fish and Wildlife Agencies shall be responsible for identifying the onset of a Changed Circumstance, using information obtained from system-wide or effectiveness monitoring, scientific study, or information provided by other sources. Once the Implementation Office and/or the Fish and Wildlife Agencies has become aware that a Changed Circumstance has occurred or is likely to occur, they will take immediate steps to investigate and confirm the event. The Implementation Office shall notify the Authorized Entity Group, the Permit Oversight Group and the Stakeholder Council of the change in circumstances.

After documenting the occurrence of a Changed Circumstance, the Implementation Office will determine specific responsive actions that are consistent with the requirements set out in Chapter 6.4.2 and develop a schedule for their implementation. The Implementation Office will confer with the Fish and Wildlife Agencies regarding the details of the response and a timeframe for implementation. For actions implemented through the adaptive management and monitoring program, the decision-making process described in Chapter 3.6 will be used. After implementing such actions, the Adaptive Management Team will oversee monitoring efforts to determine the effectiveness of the responsive actions and report the associated result and finding through the annual reporting process.

13.0 FUNDING

The Parties recognize that the ESA and the NCCPA each require that adequate funding will be assured to implement an HCP and/or an NCCP. The Parties acknowledge that such assurances do not require that all necessary funds be secured at the time of permit issuance, but rather establish that such funding is reasonably certain to occur during the course of Plan implementation.

The Permittees agree to provide such funds as may be necessary to carry out their obligations under the BDCP. Furthermore, as described in Chapter 8 of the Plan, the State and federal governments have committed to provide additional funding to implement the Plan. The Parties agree that the detailed accounting of the estimated costs associated with the various components of the BDCP, as set out in Chapter 8.2 and Tables 8-5 through 8-36, reflect best efforts to determine the level of funding necessary to implement the Plan.

The Parties and Reclamation have identified the various sources from which funding will likely be drawn, as described in Chapter 8.3 and Tables 8-37 through 8-59, sufficient to support a viable funding strategy. Such sources of funding include State and federal water contractor revenue, contractor-issued bonds, State-issued bonds, federal agency appropriations, and State and federal grants.

The Parties acknowledge that the sources of funding identified in the Plan, including bonds for infrastructure, have historically proven to be reliable means by which public projects may be funded. In addition, the primary sources of funding that the Parties intend to rely upon are typical of the type of sources that are generally available to public agencies to fund large-scale infrastructure and mitigation projects.

The Parties agree that the assessment of funding requirements for the BDCP, the viability of the sources identified for such funding, and the commitments made by the Parties in the Plan and this Agreement provide an adequate basis for a finding by the State and federal Fish and Wildlife Agencies that sufficient assurances of funding have been provided pursuant to the ESA and the NCCPA. In the event that certain sources of funds cease to be available or circumstances warrant a reexamination of the viability of the

BDCP funding strategy, Section 13.2 of this Agreement will guide the Parties in their efforts to remedy any actual or imminent shortfall.

13.1 Obligations of the Parties

The overall level of funding required for the implementation of the Plan is set out in Chapter 8 and this Agreement. The Parties acknowledge and agree that the overall level of funding set out in the Plan represents a best estimate of such costs and that the funding obligations of the Parties, as described in the Plan and this Agreement, will be fulfilled over the course of Plan implementation. The Plan and this Agreement contain provisions for periodic evaluation of funding and for addressing any potential for inadequate funding.

13.1.1 Obligations of the Authorized Entities

The Authorized Entities shall be responsible for funding a share of the overall cost of the BDCP, as set forth in the Plan. The Authorized Entities will provide funding equal to the costs associated with the construction, operation, and maintenance of the new conveyance infrastructure set out in CM1 and for the mitigation associated with such infrastructure, as described in Chapter 8.3.4. The Authorized Entities will contribute towards all other Conservation Measures and related program elements, as described in the column "Amount Paid by Contractors" in Table 8-41 in Chapter 8.3.4.1. [Note to Reviewers: This amount in table 8-41 of the draft BDCP totals $903 million]. Consistent with the foregoing, the Authorized Entities shall not be obligated to provide, either directly or through another agency, funding to implement any other elements of the Plan.

13.1.2 Obligations of California and the United States

[Note to Reviewers: no Federal Administration Position on Financing – While the United States has been engaged in the development of this draft Agreement, there is no federal position as of this time regarding potential funding obligations of the United States. The Parties anticipate reaching agreement on a federal and state cost share.]

Subject to the limitations in Section 24.15 of this Agreement, and as described in Chapter 8 Tables 8-37 through 8-40, the State of California, acting through the appropriate State agency or agencies and the United States, acting through the appropriate federal agency or agencies, shall be responsible for funding the implementation of the Plan, except as funded by the Authorized Entities pursuant to 13.1.1, which will include the Supplemental Adaptive Management Fund.

13.1.3 Additional Funding Opportunities

To provide supplemental funding for Plan implementation, State, federal, and local agencies, including any of the Parties, may pursue funding from sources other than SWP

and CVP contractors. Such sources include those identified in BDCP Chapter 8.3 (including Tables 8-37, 8-39, 8-40, 8-48 through 8-55), as well as other sources that may be available. If Reclamation or DWR, or other State or federal agencies, pursue such funding for purposes of satisfying costs of Plan implementation that are not obligations of the CVP and SWP contractors, then Reclamation and DWR shall not directly, or otherwise charge or pass such costs to the SWP/CVP contractors.

13.2 Inadequate Funding

Subject to the limitations in Section 24.15 of this Agreement, the Parties and Reclamation have committed to provide substantial resources to ensure the proper implementation of the BDCP and, through the Plan and this Agreement, have provided assurances that adequate funding for such purposes will be available and forthcoming.

A Fish and Wildlife Agency determination that the BDCP is not being adequately funded shall require a demonstration that: 1) a funding shortfall exists; and 2) such shortfall either a) prevents a specific action or actions from being implemented in a timely manner, as defined by the rough proportionality criteria set out in Chapter 6, or b) prevents a specific action or actions from being properly and fully implemented, as described in the relevant provisions of the BDCP.

In the event of a funding shortfall from the Authorized Entities, the Fish and Wildlife Agencies will evaluate the impact of the shortfall on Plan implementation and determine whether the funding deficiency should affect the scope or ongoing viability of the regulatory authorizations. The Plan and this Agreement contain provisions that provide for rough proportionality and that are intended to ensure there would be no mitigation debt in the event of inadequate funding. If circumstances warrant suspension or revocation of one or both of the Federal Permits (and/or invalidation of Reclamations' Incidental Take Statement) USFWS and NMFS may proceed pursuant to procedures in Sections 22.1, 22.2 and 22.3 of this Agreement. If CDFW determines adequate funding is not being provided by the Authorized Entities, CDFW may suspend or revoke the State Permit, in whole or in part, pursuant to the procedures in Section 22.4 of this Agreement. If the Authorized Entities elect to institute measures to cure the funding shortfall, implementation of such measures shall begin no later than ninety (90) days from the date of the meeting with the Fish and Wildlife Agencies.

In the event of a shortfall in State or federal funding, a Fish and Wildlife Agency(ies) shall not suspend or revoke the State and/or Federal Permits or invalidate Reclamation's take statement if the shortfall in funding is determined to be likely to have no more than a minimal effect on the capacity of the Plan to advance the biological goals and objectives.

The Parties have committed to provide substantial resources to ensure the proper implementation of the Plan. The Plan is designed to demonstrate that this funding will be adequate for such purposes and will be forthcoming. However, in the unanticipated event

of a shortfall in State or federal funding, the Implementation Office will make reasonable adjustments to expenditures to continue to meet the obligations of the Plan. If these adjustments are inadequate to meet Plan requirements, the Implementation Office will confer with the Fish and Wildlife Agencies to identify alternative courses of action. Actions that may be considered to address such shortfalls include adjusting the scope of the Plan in proportion to the public funding shortfall. Such actions may focus initially on the terrestrial components of the Plan and would be incorporated into the Plan through the formal amendment process described in Chapter 6.5.3 of the Plan and Section 23.3 of this Agreement. The Authorized Entities will not be required to provide land, water, or monetary resources beyond their commitments in this Plan in the event of a shortfall in State or federal funding.

14.0 ASSURANCES AND PROTECTIONS

The ESA regulations and provisions of the NCCPA provide for regulatory and economic assurances to Parties covered by approved HCPs or NCCPs concerning their financial obligations under a plan. Specifically, these assurances are intended to provide a degree of certainty regarding the overall costs associated with mitigation and other Conservation Measures, and add durability and reliability to agreements reached between permit holders and the Fish and Wildlife Agencies. That is, if unforeseen circumstances occur that adversely affect species covered by an HCP or an NCCP, the Fish and Wildlife Agencies will not require of the permit holder any additional land, water, or financial compensation nor impose additional restrictions on the use of land, water, or other natural resources without their consent.

The assurances provided under the ESA and the NCCPA do not prohibit or restrain USFWS, NMFS, CDFW, the Permittees or any other public agency from taking additional actions to protect or conserve species covered by an NCCP or HCP. The State and federal agencies may use a variety of tools at their disposal and take actions to ensure that the needs of species affected by unforeseen events are adequately addressed.

14.1 Regulatory Assurances under the ESA – The No Surprises Rule

Under the No Surprises rule (63 Fed. Reg. 8859 (Feb. 23, 1998)), once an incidental take permit has been issued pursuant to an HCP, and its terms and conditions are being properly implemented, the federal Fish and Wildlife Agencies will not require additional measures for Changed Circumstances not provided for in the plan or for unforeseen circumstances, without the consent of the Permittee, including land, water (including quantity and timing of delivery), financial compensation, or restrictions on the use of those resources (63 Fed. Reg. 8859, 8868 (Feb. 23, 1998)). If the status of a species addressed under an HCP unexpectedly declines because of unforeseen circumstances, the primary obligation for undertaking additional conservation measures rests with the federal government, other government agencies, or other nonfederal landowners who have not yet developed HCPs.

However, the federal Fish and Wildlife Agencies may, in the event of unforeseen circumstances, require additional measures provided they are limited to modifications in conserved natural community areas or to the HCP's operating conservation program (*e.g.*, the Conservation Strategy) for the affected species, and that these measures do not involve additional financial commitments or resource restrictions without the consent of the Permittee. These assurances are provided to all HCP permittees that properly implement their plans. The No Surprises rule, however, does not apply to federal agencies. 50 C.F.R. § 222.307(g).

14.2 Regulatory Assurances under the Natural Community Conservation Planning Act

Under the NCCPA, CDFW provides assurances to permittees commensurate with the long-term conservation assurances and associated implementation measures that will be implemented under a plan (Fish & Game Code § 2820(f)). In its determination of the level and duration of the assurances to be afforded a permittee, CDFW takes into account the conditions specific to the plan, including such factors as:

- The level of knowledge of the status of covered species and natural communities;
- The adequacy of analysis of the impact of take on covered species;
- The use of the best available science to make assessments of the impacts of take, reliability of mitigation strategies, and appropriateness of monitoring techniques;
- The appropriateness of the size and duration of the plan with respect to quality and amount of data;
- The sufficiency of mechanisms for long-term funding of all components of the plan and contingencies;
- The degree of coordination and accessibility of centralized data for analysis and evaluation of the effectiveness of the plan;
- The degree to which a thorough range of foreseeable circumstances are considered and provided for under the adaptive management program; and
- The size and duration of the plan.

The assurances provided to the entities receiving permits under the NCCPA will ensure that if there are unforeseen circumstances, no additional financial obligations or restrictions on the use of resources will be required of the Permittees without their consent. Specifically, the NCCPA directs that,

> [i]f there are unforeseen circumstances, additional land, water, or financial compensation or additional restrictions on the use of land, water, or other natural resources shall not be required without the consent of plan participants for a period of time specified in the implementation agreement, unless CDFW determines that the plan is not being implemented consistent with the substantive terms of the implementation agreement (Fish & Game Code § 2820(f)(2)).

The NCCPA requires that CDFW suspend or revoke a permit, in whole or in part, if the continued take of a Covered Species would jeopardize its continued existence.

14.3 USFWS and NMFS

14.3.1 Permittees

Pursuant to the No Surprises Rule at 50 C.F.R. §§ 17.22(b)(5), 17.32(b)(5), and 222.307(g), and provided that the BDCP is being implemented consistent with the terms of this Agreement, the Plan, and the Federal Permits, the USFWS and NMFS shall not require the Permittees to provide additional land, water or other natural resources, or financial compensation or additional restrictions on the use of land, water, or other natural resources beyond the level provided for under the BDCP, this Agreement and the Federal Permits with respect to Covered Activities without the consent of the Permittees. Adaptive management modifications and planned responses to Changed Circumstances are provided for under the BDCP, as set out in Chapter 3.6 and Chapter 6.4.2. Accordingly, the resources identified to support such modifications and planned responses, together with the other resources commitments of the Permittees reflected in the Plan, this Agreement and the associated regulatory authorizations, constitute the extent of the obligations of the Permittees pursuant to the No Surprises Rule.

14.3.2 Reclamation

The No Surprises Rule does not apply to federal agencies. In light of Reclamation's integral role in the BDCP, it is appropriate to provide to Reclamation a degree of certainty regarding its obligation to fund Conservation Measures, and to provide durability and reliability regarding BDCP implementation. In that regard, USFWS and NMFS agree that once the Integrated Biological Opinion has been issued: (1) to the maximum extent allowed by law, Reclamation's ongoing responsibilities for Associated Federal Actions under Section 7(a)(2) of the ESA will be fulfilled through Reclamation's participation in the BDCP, including through the obligations it has assumed under the adaptive management and the Changed Circumstances provisions of the Plan; and (2)

USFWS and NMFS agree that Reclamation will not be required to provide additional commitments or measures for Associated Federal Actions beyond those set forth in the BDCP without first attempting to resolve issues through the review process in Section 15.8, if invoked by an Authorized Entity, and exhausting processes set forth in Section 22.5 of this Agreement.

14.3.3 Unforeseen Circumstances

Under the ESA regulations and this Agreement, if unforeseen circumstances arise during the life of the BDCP, USFWS and/or NMFS may not require the commitment of additional land or financial compensation, or additional restrictions on the use of land, water, or other natural resources other than those agreed to in the Plan.

Within these constraints, USFWS and/or NMFS may require additional measures, but only if the following conditions apply:

- The agencies prove an unforeseen circumstance exists.
- Such measures are limited to modifications within any conserved habitat areas or to the Conservation Measures for affected Covered Species.
- The original terms of the Plan will be maintained to the maximum extent possible.
- The overall cost of implementing the BDCP is not increased by the modification.

Pursuant to 50 C.F.R. §§ 17.22(b)(5)(iii)(C), 17.32(b)(5)(iii)(C), and 222.307(g)(3)(iii), the USFWS or NMFS has the burden of demonstrating that unforeseen circumstances exist, using the best scientific and commercial data available. The USFWS and NMFS will consider input submitted by the Authorized Entities prior to making that determination. A finding of unforeseen circumstances must be made considering the following six factors: (1) size of the current range of the affected species; (2) percentage of range adversely affected by the conservation plan; (3) percentage of range conserved by the conservation plan; (4) ecological significance of that portion of the range affected by the conservation plan; (5) level of knowledge about the affected species and the degree of specificity of the species' conservation program under the conservation plan; and (6) whether failure to adopt additional Conservation Measures would appreciably reduce the likelihood of survival and recovery of the affected species in the wild. If such a finding is made and additional measures are required, the Authorized Entities will work with CDFW, USFWS and/or NMFS to appropriately redirect resources to address the unforeseen circumstances, consistent with the intent of the BDCP.

If USFWS or NMFS believe an unforeseen circumstance exists, it shall provide written notice of its proposed finding of unforeseen circumstances to the Implementation Office. The USFWS or NMFS shall clearly document the basis for the proposed finding regarding the existence of unforeseen circumstances pursuant to the requirements of 50 C.F.R. §§ 17.22(b)(5)(iii)(C), 17.32(b)(5)(iii)(C), and 222.307(g)(3)(iii). Within fifteen (15) days of receiving such notice, the Authorized Entities, the Program Manager, and the USFWS and NMFS shall meet and confer to consider the facts cited in the notice and potential changes to the Conservation Strategy.

14.4 CDFW

14.4.1 Permittees

Provided the BDCP is being implemented consistent with the substantive terms of this Agreement, the Plan, and the State Permit, CDFW agrees that it will not require from the Permittees additional land, water or financial compensation or additional restrictions on the use of land, water, or other natural resources for the 50 year term of the State Permit without the consent of Permittees. Adaptive management modifications and Plan responses to Changed Circumstances are provided for under the BDCP, as set out in Chapter 3.6, and Chapter 6.4.2. Accordingly, the resources identified to support such modifications and planned responses, together with the other resources commitments of the Permittees reflected in the Plan, constitute the extent of the obligations of the Permittees, pursuant to the assurances provided for in the NCCPA. Section 2823 of the NCCPA provides, however, that CDFW shall suspend or revoke any permit, in whole or in part, issued for the take of a species subject to Section 2835 if the continued take of the species would result in jeopardizing the continued existence of the species. Responses to a jeopardy determination are addressed in Section 22.6 of this Agreement.

14.4.2 Unforeseen Circumstances

As specified in Section 14.4.1, CDFW agrees that it will not require of the Permittees additional land, water, or financial compensation or additional restrictions on those resources without the consent of the Permittees for the 50 year term of the BDCP and this Agreement. In the event of unforeseen circumstances, CDFW shall make an unforeseen circumstances finding based on the best scientific evidence available, after considering any responses submitted by the Permittees. If such a finding is made and additional measures are required, the Authorized Entities will work with CDFW, USFWS and NMFS to appropriately redirect resources to address the unforeseen circumstances, consistent with the intent of the BDCP.

If CDFW believes an unforeseen circumstance exists, it shall provide written notice of its proposed finding of unforeseen circumstances to the Implementation Office. CDFW shall clearly document the basis for the proposed finding regarding the existence of unforeseen circumstances. Within fifteen (15) days of receiving such notice, the

Authorized Entities, the Program Manager, and CDFW shall meet and confer to consider the facts cited in the notice and potential changes to the Conservation Strategy.

14.4.2.1 Interim Obligations upon a Finding of Unforeseen Circumstances under the ESA or NCCPA

If a Fish and Wildlife Agency finds that an Unforeseen Circumstance has occurred with regard to a Covered Species and that additional measures are required for the Covered Species as a result, during the period necessary to determine the nature, scope and location of any additional measures, the Permittees will avoid causing an appreciable reduction in the likelihood of the survival and recovery of the affected species. The Permittees will not be responsible for implementing any additional measures unless the Permittees consent to do so.

15.0 IMPLEMENTATION STRUCTURE

15.1 Approach to BDCP Governance and Implementation

The implementation of the BDCP will generally be effectuated through an Implementation Office, which will be managed by a Program Manager and governed by the Authorized Entities through the "Authorized Entity Group." The Authorized Entities shall have ultimate responsibility for the actions undertaken by the Implementation Office. The Fish and Wildlife Agencies will maintain an ongoing role in Plan implementation, including participation in a Permit Oversight Group, to ensure that such implementation proceeds in a manner consistent with the BDCP and its associated regulatory authorizations. Through the Permit Oversight Group, the Fish and Wildlife Agencies will be involved in certain specified implementation decisions and will lend technical and scientific expertise to the implementation process. In addition, a "Stakeholder Council" shall be created and regularly convened to enable public agencies, non-governmental organizations, interested parties, and the general public to provide ongoing input into the implementation process and to effectively discuss and resolve issues in dispute.

15.2 Implementation Office

15.2.1 Purpose and Function

The Program Manager will establish, organize, and direct the Implementation Office. To ensure that the commitments reflected in the BDCP are carried out in a timely and efficient manner, the Program Manager, through the Implementation Office, will institute processes and procedures to adequately address planning, budgeting, sequencing, and scheduling needs related to Plan implementation. The Implementation Office will function with a significant level of independence from its member entities. However, the Program Manager and the Implementation Office staff will work closely with these entities on a range of matters, particularly with respect to actions that affect water

operations, and will be responsive to the Authorized Entity Group, regardless of the entity through which the Program Manager and the Implementation Office staff have established employment relationships. In addition, for those activities involving functions that, under State and federal law, cannot be delegated (e.g., water operations, water contracting, procurement, expenditures of State and federal funds), the Program Manager will coordinate with the appropriate designated State or federal official to ensure that the necessary function is carried out. The Program Manager will also, to the extent appropriate, solicit input from the Stakeholder Council on a range of implementation matters.

Specifically, under the direction of the Program Manager, the Implementation Office shall assume responsibility for the implementation of a broad range of actions, as identified in Chapter 7, including:

- Oversight and coordination of administration of program funding and resources.
- Preparation of annual budgets and work plans.
- Establishment of procedures and approaches to implement Plan actions.
- Planning, oversight, and implementation of actions set out in the Conservation Measures.
- Technical and logistical support to the Adaptive Management Team with respect to the administration of the Adaptive Management and Monitoring Program.
- Coordination with Delta-wide governance entities, including the Delta Stewardship Council, the Delta Science Program, and the Delta Conservancy.
- Implementation of public outreach program.
- Fulfillment of compliance monitoring and reporting requirements, including the preparation of annual reports.
- Reporting, at least on an annual basis, to the Delta Stewardship Council on the status of Plan implementation, including on matters related to the adaptive management and monitoring activities.

The Implementation Office shall not be responsible for certain implementation actions. Specifically, the Implementation Office will have limited, if any, involvement in the following matters:

- The Implementation Office shall not be involved in the construction or operation of SWP and/or CVP facilities other than to monitor infrastructure development and water operations for the purpose of assembling the information necessary to evaluate and report on compliance with the terms and conditions of the Plan, the Implementing Agreement, and the associated regulatory authorizations, as described in Chapter 6.4. The BDCP sets out the parameters within which DWR and Reclamation will conduct SWP and CVP operations and infrastructure development. DWR and Reclamation may choose to operate the SWP and CVP and develop new project infrastructure using their current organizational capacity or by contract with other entities.

- The Implementation Office shall not administer the Adaptive Management and Monitoring Program. Rather, the program will generally be administered by the Adaptive Management Team, which will be chaired by the Science Manager (See Chapter 3.6.2.1). The Implementation Office will provide logistical and technical support to the Adaptive Management Team.

The Program Manager will also organize, convene, and provide support to the Authorized Entity Group and its proceedings, including its meetings with the Permit Oversight Group. In the event that the Program Manager position is vacant, then DWR and Reclamation will designate agency staff to serve this role until such time as the position has been filled. The Program Manager will further ensure that the Authorized Entity Group receives and reviews all proposed work plans, reports, budgets, and other relevant information generated by the Implementation Office, the Fish and Wildlife Agencies, the Adaptive Management Team, and other sources. The Program Manager will further ensure that the Authorized Entity Group has sufficient opportunity to provide input regarding these documents.

The Implementation Office shall implement a public outreach and education program to promote public awareness and provide opportunities for public input on matters concerning Plan implementation, as described in Chapter 7.5. The outreach program shall meet the following objectives.

- Promote public awareness of and understanding about the Plan's purpose, specific Conservation Measures and their implementation.

- Provide streamlined and timely access to information.

- Provide opportunities to engage with decision-makers.

- Maintain a transparent process for understanding, clarifying and addressing public input and comments.

Particular emphasis will be placed on outreach efforts focused on the following stakeholders: Delta residents, including landowners, farmers, and business owners; environmental community; agricultural community; boaters; commercial fishing interests; recreational anglers; local governments; reclamation districts; irrigation districts; public utilities; public and private landowners adjacent to BDCP conservation areas; and Native American tribes. In addition, to further facilitate access to information and promote transparency in decision-making, the Implementation Office shall maintain a public, on-line database of key documents and information, such as annual implementation reports, work plans, and budgets.

15.2.2 Legal Status

The Implementation Office will not be a legal entity and, therefore, will not be authorized to enter into contracts directly or hold property in its own name. As such, the Implementation Office will administer the implementation of the BDCP under the existing authorities of the Authorized Entities.

15.2.3 No Delegation of Authority

The assignment of responsibility to the Program Manager and the Implementation Office will not alter or modify existing authorities, mandates, and obligations of the Authorized Entities or any other State and federal agency participating in Plan implementation. No general delegation of authority by the Authorized Entities to the Implementation Office, including the Program Manager or to any employee assigned to the Implementation Office will occur, although specific delegation may occur in the event that it is considered by the delegating Authorized Entity to be beneficial to the efficient operation of the Implementation Office. Any such delegation will be conferred, in writing, by the delegating Authorized Entity to the Program Manager, and will be reviewed by that agency from time to time. No unauthorized delegation of State or federal authority to the Program Manager or the Implementation Office will occur.

15.2.4 Implementation Office Management and Other Staff

15.2.4.1 Program Manager

The Program Manager will manage, coordinate, oversee, and report on all aspects of Plan implementation, subject to the oversight of the Authorized Entity Group and consistent with certain limitations related to the development, operation, and maintenance of the SWP and CVP facilities and the administration of the Adaptive Management and Monitoring Program. The Program Manager will report to the Authorized Entity Group, and act in accordance with the Group's direction.

The Authorized Entity Group will select the Program Manager. Prior to making its selection, the Authorized Entity Group will: solicit qualified candidates for the Program Manager position; confer with the Permit Oversight Group regarding the selection

process and the qualifications of the candidates; invite the Permit Oversight Group to participate in the interview process; and confer with the Stakeholder Council regarding the selection process. The Program Manager shall meet the qualifications set out in Chapter 7.1.1.1.

15.2.4.2 BDCP Science Manager

The Program Manager will select a Science Manager. Prior to making the selection, the Program Manager will: consult with the Authorized Entity Group and the Permit Oversight Group regarding the selection process and the qualifications of the candidates; invite the Authorized Entity Group and the Permit Oversight Group to participate in the interview process; and confer with the Stakeholder Council regarding the selection process. The Science Manager must meet the qualifications set out in Chapter 7.1.1.2. The Science Manager will report to the Program Manager.

The responsibilities of the Science Manager will include:

- Serve as Chair of the Adaptive Management Team and assist the team in the development and administration of the Adaptive Management and Monitoring Program, in coordination with the Interagency Ecological Program and other science programs.

- Serve as a member of the IEP Coordinators.

- Engage in regular communication and coordination with the Delta Science Program and the Independent Science Board, in a manner consistent with Water Code § 85820, as well as other outside scientists and, with guidance from the Adaptive Management Team, coordinate or contract with the Independent Science Board, the Delta Science Program, or other scientists to obtain input and review, to support the Adaptive Management and Monitoring Program.

- Support the Program Manager in the preparation of plans, reports and other technical documents.

- Assist in building sufficient scientific capacity and resources within the Implementation Office and the IEP to advance the goals and objectives of the BDCP.

- Assist the Adaptive Management Team in synthesizing and presenting the results of studies and research, compiling the findings of monitoring efforts, and summarizing the current scientific knowledge on relevant Delta resources to the Program Manager, Authorized Entity Group, Permit Oversight Group, Stakeholder Council, and others.

15.2.4.3 Staff

The Program Manager will fulfill the staffing needs of the Implementation Office by drawing from existing personnel at DWR, Reclamation, State and Federal Water Contractors Agency (SFWCA), and from other sources, including from sources outside of agencies, if appropriate and if such personnel possess the expertise and experience necessary to carry out the tasks associated with implementation. The specific staffing needs of the Implementation Office will be determined by the Program Manager, with input from the Authorized Entity Group and the Permit Oversight Group. Staff assigned to the Implementation Office will act under the direction of the Program Manager. The engagement of personnel from DWR, Reclamation, and other entities, however, will not affect or modify the existing authorities of federal, State, and local agencies or nongovernmental organizations that pertain to personnel matters. Personnel may be retained under the Intergovernmental Personnel Act (5 U.S.C. §§ 3371–3375); through personal services contracts, or other appropriate mechanisms. The Authorized Entities and the Fish and Wildlife Agencies will each designate a representative from their respective agencies to serve as liaisons to the Implementation Office.

15.2.4.4 Conservation Measure Implementation Actions

The Implementation Office shall be responsible for planning, design and implementation of Conservation Measures, as described in more detail in Chapter 3.6.3.5.1 of the Plan. As such, these activities shall not be subject to the processes set out in Section 10.3 and will not require the approval or concurrence of the Authorized Entities, the Fish and Wildlife Agencies, or the Adaptive Management Team.

15.3 BDCP Authorized Entity Group

15.3.1 Purpose and Function

The Authorized Entity Group shall be established to provide program oversight and general guidance to the Program Manager regarding the implementation of the Plan. The Authorized Entity Group will consist of the Director of DWR, the Regional Director for Reclamation, a representative of the SWP contractors and a representative of the CVP contractors. The Authorized Entity Group will be responsible for ensuring that the management and implementation of the BDCP are carried out consistent with its provisions, this Agreement, and the associated regulatory authorizations.

The Authorized Entity Group will provide oversight and direction to the Program Manager on matters concerning the implementation of the BDCP, provide input and guidance on general policy and program-related matters, monitor and assess the effectiveness of the Implementation Office in implementing the Plan, and foster and maintain collaborative and constructive relationships with the Fish and Wildlife Agencies, other public agencies, stakeholders and other interested parties, and local government throughout the implementation of the BDCP.

The Authorized Entity Group will engage in a number of specific matters including, but not limited to, the following:

- Provide oversight of the administration and funding of implementation activities.

- Provide oversight regarding the implementation of non-water related Conservation Measures by the Implementation Office.

- Approve, jointly with the Permit Oversight Group, changes to Conservation Measures or biological objectives proposed by the Adaptive Management Team.

- Decide, jointly with the Permit Oversight Group, all other adaptive management and monitoring program matters for which concurrence has not been reached by the Adaptive Management Team.

- Approve, jointly with the Permit Oversight Group, the Annual Monitoring and Research Plan.

- Select the Program Manager and provide input into the selection of the Science Manager.

- Review and approve the Annual Work Plan and Budget.

- Review and approve Annual Progress Reports, including Annual Delta Water Operations Reports, and other compliance-related documents.

- Review and approve submission of Plan amendments to the Permit Oversight Group.

15.3.2 No Delegation of Authority

The participation of the Authorized Entities on the Authorized Entity Group will not trigger or otherwise cause a delegation of authority or responsibility for any of the implementation actions described in the BDCP from one Authorized Entity to another or to the Implementation Office. Rather, the specific roles and level of involvement in implementation actions are defined either by existing statutory or regulatory authorities or by provisions set out in the Plan and this Agreement. For many of the BDCP actions and commitments, a specific Authorized Entity will have the sole responsibility for implementation; for other actions and commitments established by the Plan, the Authorized Entities may be jointly and severally responsible for their implementation. For instance, the operation of the SWP will remain under the control and responsibility solely of DWR; likewise, the operation of the CVP will continue to be under the control

and responsibility of Reclamation. As such, while it is expected that the Authorized Entity Group will express a single position of the group regarding a matter under its consideration, the entity(ies) with vested statutory or regulatory authority over the matter will make the final determination.

15.3.3 Meetings of the Authorized Entity Group

The Authorized Entity Group will meet on a schedule of its own choosing, but at a minimum on a quarterly basis. The Authorized Entity Group may also be convened by the Program Manager, as needed, to review issues that arise during the implementation of the Plan, including proposed amendments to the Annual Work Plan and Budget. The Authorized Entity Group will also meet with the Permit Oversight Group (Chapter 7.1.3), at least on a quarterly basis to review Plan implementation issues, including those related to the adaptive management and monitoring program and the restoration and preservation of habitat.

The Authorized Entity Group shall have the responsibility to inform the public of its deliberations and decisions. As such, the Program Manager will ensure that the public receives notice of upcoming meetings of the Authorized Entity Group, that meeting agendas are posted prior to such meetings, and that any decisions of the Authorized Entity Group are made available through the BDCP website. On a periodic basis, the Authorized Entity Group will hold meetings that are open to the public. The Authorized Entity Group will institute procedures with respect to public notice of and access to these meetings and to any public meetings it holds with the Permit Oversight Group. The date, time, and location of the meetings will be posted on the BDCP website at least ten (10) days prior to such meetings. The meetings will be held at locations within the City of Sacramento or the legal Delta.

15.4 Permit Oversight Group

15.4.1 Purpose and Function

The Permit Oversight Group will consist of the Fish and Wildlife Agencies, specifically, the Regional Director of USFWS, the Regional Administrator of NMFS, and the Director of CDFW. Consistent with their authorities under the ESA and the NCCPA, the Fish and Wildlife Agencies will retain responsibility for monitoring compliance with the BDCP, approving certain actions, and enforcing the terms and conditions of their respective regulatory authorizations. In addition to fulfilling those regulatory responsibilities, the Fish and Wildlife Agencies will also provide technical input on a range of implementation actions that will be carried out by the Implementation Office.

To ensure that the BDCP is being properly implemented, the Permit Oversight Group will coordinate agency review of the actions being implemented under the Plan and assessments of compliance with the provisions of the Plan, this Agreement, and associated regulatory authorizations. The Permit Oversight Group will be involved in

certain decisions relating to the implementation of water operations and other Conservation Measures, actions proposed through the adaptive management program or in response to Changed Circumstances, approaches to monitoring and scientific research. The Implementation Office will work with the Permit Oversight Group and the Authorized Entity Group to institute mutually agreeable processes to enhance opportunities for such collaboration and engagement.

The Permit Oversight Group will have the following roles, among others, in implementation matters:

- Approve, jointly with the Authorized Entity Group, changes to Conservation Measures or biological objectives proposed by the Adaptive Management Team.

- Decide, jointly with the Authorized Entity Group, all other adaptive management and monitoring program matters for which concurrence has not been reached by the Adaptive Management Team.

- Approve, jointly with the Authorized Entity Group, the Annual Monitoring and Research Plan.

- Participate in decision-making regarding real-time operations, consistent with the criteria of *CM1 Water Facilities and Operation* and other limitations set out in the BDCP and annual Delta water operations plans.

- Provide input into the selection of the Program Manager and the Science Manager.

- Provide input and concurrence with respect to the consistency of specified sections of the Annual Work Plan and Budget with the BDCP and with certain agency decisions.

- Provide input and concur with the consistency of the Annual Delta Water Operations Plan with the BDCP.

- Provide input and accept Annual Progress Reports, including Annual Delta Water Operations Reports.

- Provide input and approve Plan amendments.

15.4.2 Positions of the Permit Oversight Group

For those actions that are regulatory in nature or require the concurrence and/or approval of the Permit Oversight Group, there will be one written communication, to the maximum extent practicable, relaying the position of the Permit Oversight Group on the

issue in question. In developing this communication, the three member agencies will coordinate with each other to evaluate interspecies conflicts and determine actions that meet the needs of all Covered Species, and they will ensure consistency among the federal agencies and, to the extent possible, among all three agencies in the application of their respective regulatory authority. Subject to the requirements for consistency above, nothing in this Agreement will limit the ability of any Permit Oversight Group agency to exercise its discretion through individual correspondence in circumstances where project operating agency action is imminent and there is not sufficient time to coordinate correspondence. Nothing in the this Agreement will limit application of authorities with respect to necessary Section 7 correspondence related to annual or seasonal operations of the CVP.

15.5 Adaptive Management Team

The Adaptive Management Team will have primary responsibility for administration of the adaptive management and monitoring program. The specific roles and responsibilities of the Adaptive Management Team are described in Chapter 3.6.2 and Section 10.3.2 of this Agreement.

15.6 BDCP Stakeholder Council

15.6.1 Purpose and Function

The Stakeholder Council will be formed to provide opportunities for interested parties to consider, discuss, and provide input on matters related to the implementation of the BDCP. The primary purpose of the Stakeholder Council is to provide a forum for the BDCP stakeholders to assess the implementation of the Plan, and to propose to the Implementation Office ways in which Plan implementation may be improved. The BDCP Stakeholder Council will be organized and convened by the Program Manager, who will also serve as a member of the Stakeholder Council.

For the benefit of the Stakeholder Council members and the general public, the Program Manager will provide information and conduct briefings regarding Plan implementation. Briefings will include presentations of drafts of the Annual Progress Report, Annual Work Plan and Budget, Annual Delta Water Operations Plan, the Annual Water Operations Report, Five Year Comprehensive Review, and the Five Year Implementation Plan, as described in Chapter 6.

The Stakeholder Council will develop its own process to consider and provide input regarding the various aspects of BDCP implementation, including matters related to work plans and budgets, the Annual Delta Water Operations Plan, implementation of Conservation Measures, adaptive management changes, monitoring and reporting activities, scientific research and review processes, and annual reports. A Technical Facilitation subgroup will be established to provide input to the Implementation Office and the Adaptive Management Team on technical and scientific matters. The

Stakeholder Council process will complement, but not substitute for, ongoing collaboration and communication between stakeholders and the Implementation Office, Authorized Entities, the Authorized Entity Group, the Permit Oversight Group, and the Fish and Wildlife Agencies. The Implementation Office will organize, help convene, and provide support to the Stakeholder Council and its proceedings.

15.6.2 Membership

The Stakeholder Council will consist of representatives from a range of entities and organizations with an interest in BDCP-related issues or otherwise engaged in BDCP matters. At a minimum, representatives of the following entities will be invited to participate on the Council:

- Representatives of DWR and Reclamation
- Representatives of SWP/CVP Contractors
- Representatives of Other Authorized Entities
- Representatives of USFWS, NMFS, and CDFW
- Representatives of other State and federal regulatory agencies, including the Army Corps of Engineers, the U.S. Environmental Protection Agency, and State Water Resources Control Board
- A representative of the Delta Stewardship Council
- A representative of the Delta Protection Commission
- A representative of the Delta Conservancy
- A representative of the Central Valley Flood Protection Board
- Representatives of the counties of San Joaquin, Sacramento, Solano, Yolo, and Contra Costa

Additional members will be selected from the following categories by the Secretary of the California Natural Resources Agency, in consultation with the directors of the relevant departments comprising the Agency, such as DWR and CDFW. The public may submit nominations to the Secretary for these additional members. Each member will serve a term of four years, and may be reappointed without limit and may serve until such time as they are replaced.

- At least three representatives from conservation groups with expertise in fish and wildlife management and/or the management of aquatic habitats and other natural lands

- At least three representatives of local government agencies within the Delta.

- At least one representative of fishing organizations

- At least one representative of hunting organizations

- At least one representative of recreational organizations

- At least two representatives of Delta reclamation districts

- At least two representatives of Delta agriculture

- At least three scientists with expertise in the management of natural lands, and native plant and animals species

- At least one representative of water agencies located in the Sacramento valley

- At least one representative of water agencies in the San Joaquin River watershed

- One representative from organized labor working in the building trades

- One representative from the exclusive representatives of State-employed scientific or engineering professionals

- Other stakeholders whose assistance will increase the likelihood of the success of Plan implementation, including Delta civic organizations and members of the general public

15.6.3 Meetings of the Stakeholder Council

The Program Manager will convene and facilitate the Stakeholder Council on at least a quarterly basis to exchange information and provide input to the Program Manager concerning the current significant issues at hand. Stakeholders will have opportunity to inquire about implementation matters, be apprised by the Program Manager of issues of interest, and make recommendations concerning pending decisions and other implementation matters. Stakeholder Council meetings will be open to the public.

15.7 Supporting Entities

15.7.1 Purpose and Function

The Implementation Office, through the Program Manager, may request that other entities, referred to as "Supporting Entities," perform certain implementation tasks, where such entities have the authority, resources, expertise, and willingness to successfully and timely undertake and complete the task. Where specific tasks are so assigned, the Program Manager will ensure that tasks and associated responsibilities are carried out properly and in coordination with other BDCP actions. The Authorized Entities and the Fish and Wildlife Agencies may also be Supporting Entities. Other Supporting Entities may include the following entities:

- The Delta Conservancy, which has been designated by statute as a primary State agency to implement ecosystem restoration in the Delta.

- Sponsors of regional conservation planning programs, including those engaged in NCCP and/or HCP development or implementation, or of other similar conservation programs, that overlap or are adjacent to the Plan Area.

- State and federal agencies.

- Other public agencies and private entities that have authority, capacity, or expertise to implement actions described in the Conservation Strategy in a cost-effective, reliable, and timely manner.

15.7.2 Administration and Oversight

The Program Manager will oversee each Supporting Entity's performance of its responsibility for carrying out a specific task. Decisions by the Program Manager to engage another entity in the implementation of specific Plan elements or actions will be accomplished by written contract (through the existing authorities of an Authorized Entity) and will be based on the entity's jurisdictional authority, level of expertise, and its capacity to carry out the element or action in a timely and successful manner. The Program Manager, with the concurrence of the Authorized Entity Group, may terminate a Supporting Entity's role in Plan implementation in the event that the Supporting Entity does not perform a task adequately. The Supporting Entity will be responsible, subject to oversight by the Program Manager, for entering into the necessary contracts and acquiring interests in real and personal property, in some cases obtaining permits or other authorizations, and taking all other steps needed to complete the implementation task.

The Take authorizations that will be issued pursuant to the BDCP will provide regulatory coverage under the ESA and the NCCPA for all activities and actions covered by the Plan. As such, no additional Take authorizations will be required to implement these

activities, regardless of whether the action is carried out by the Implementation Office or a Supporting Entity. The Permittees shall remain ultimately responsible for compliance with the Plan, this Agreement, and the associated regulatory authorizations.

15.8 Review of Disputes Regarding Implementation Matters

15.8.1 Matters Subject to Review

The Parties will be responsible for making various decisions with regard to the implementation of the BDCP. With respect to implementation matters for which the Authorized Entity Group and the Permit Oversight Group have joint decision-making authority and are unable to reach agreement, the review process described in this Section may be invoked to help resolve matters in dispute.

15.8.2 Review Process

In the event of a dispute between the Authorized Entity Group and the Permit Oversight Group, the Parties will describe the basis for the dispute and identify options that may be available to help resolve the matter. The Parties will meet and confer to consider these options and to determine whether agreement can be reached on the matter. If after the meeting the matter remains unresolved, the entity with decision-making authority, as set out in Table 7-1 of the Plan, will make a final decision.

Prior to that final decision by the entity with decision-making authority, any member of the Authorized Entity Group or the Permit Oversight Group may initiate a non-binding review process concerning the matter in dispute. A member of either group may trigger this process by providing the Authorized Entity Group and the Permit Oversight Group with a written notice of dispute that describes the nature of the dispute and a proposed approach to resolution. Such notice must be provided to the Parties within fourteen (14) days of the announcement of a tentative decision by the entity with decision-making authority. The entity with decision-making authority over the matter shall refrain from taking any actions to implement its decision until the review process has been completed.

Within fourteen (14) days of the issuance of the written notice of dispute, the Parties, with the assistance of the Implementation Office, will form a three member panel of experts. One member of the panel will be selected by the Authorized Entity Group, one member will be selected by the Permit Oversight Group, and a third member will be selected by mutual agreement of the first two panel members. Sixty (60) days after written notice of dispute, both Parties will submit letter briefs and documentary evidence. No discovery will be allowed. At its discretion, the panel may require rebuttals or responses from the Parties. If so required, the Parties will submit rebuttals or responses within thirty (30) days of the request. Also, at its discretion, the panel may meet and confer with any of the Parties regarding the matter and gather whatever available information it deems necessary and appropriate. Within sixty (60) days of the submittal of the written positions of the Parties, or rebuttals if so required, a non-binding

recommendation will be issued by a majority of the panel, in writing, which will include a statement explaining the basis for the recommendation. If the recommendation is not issued by that date, the entity with decision-making authority may make its final decision. The timely completion of the review process is important to the effective implementation of the BDCP. The schedule described above shall be adjusted as necessary to inform the decisions in a timely manner.

Within thirty (30) days of issuance of the panel's non-binding recommendation, the entity with final decision-making authority over the matter shall consider those recommendations, as well as any other relevant information concerning the issue at hand, and convey its final decision regarding the matter to the Authorized Entity Group and the Permit Oversight Group.

15.8.3 Availability of Legal Remedies

The availability of this review process will have no effect on the ability of a party to pursue legal remedies that may otherwise be available regarding a disputed matter. The recommendations of the panel are not intended to be given special deference by a reviewing court relative to the expert judgment of the agency making the final decision.

16.0 COMPLIANCE MONITORING AND REPORTING

16.1 Purpose of Compliance Monitoring

The purpose of compliance monitoring is to track progress of BDCP implementation in accordance with established timetables and to ensure compliance with terms and conditions of the BDCP and its associated regulatory authorizations. Compliance monitoring actions associated with specific Conservation Measures are set out in Chapter 3.4, and in Table 3.E-1 of Appendix 3.E of the Plan. Compliance monitoring will be conducted for all Conservation Measures, whether implemented directly by the Implementation Office or by Supporting Entities.

16.2 Responsibilities of the Implementation Office

The Implementation Office shall be responsible for ensuring that the compliance monitoring and reporting requirements of the Plan are met and for carrying out the tasks required to meet these obligations, as further described in Chapters 6 and 7. The Implementation Office may enlist the Adaptive Management Team or Supporting Entities, including the IEP and the Delta Science Program, to perform certain monitoring and reporting tasks. However, the Implementation Office shall remain solely responsible for fulfilling all monitoring and reporting requirements.

16.3 Compliance and Progress Reports

The Implementation Office shall prepare, on a periodic basis, reports documenting compliance with the provisions of the BDCP and its associated regulatory authorizations and the progress being made toward meeting the biological goals and objectives of the Plan. The Implementation Office shall, over the term of the BDCP, submit various reports and plans to the Fish and Wildlife Agencies that serve the following purposes:

- Provide the data and information sufficient to demonstrate that the BDCP is being properly implemented.

- Provide assessments regarding the effects of Plan implementation on Covered Species and the effectiveness of the Conservation Strategy at advancing the biological goals and objectives.

- Identify actions, if any, taken pursuant to the adaptive management and monitoring program and/or in response to changed or unforeseen circumstances.

- Disclose issues and challenges concerning implementation, and the potential modifications or amendments to the BDCP that may be taken to address these issue and challenges.

- Provide schedules and budget estimates associated with the implementation of Plan actions over 1-year and 5-year timeframes.

The Program Manager shall post on the BDCP website the reports and other information identified in this Section, including any subsequent revisions to those reports. As part of those postings, the Program Manager will include information, on a daily basis, about planned and actual water diversions, including updates on revisions to the Annual Delta Water Operations Plan. An accounting of actual diversions, including daily, weekly, monthly, and yearly operational levels, shall also be posted. The Program Manager will describe and explain operational changes, including departures from planned or anticipated diversion levels, in terms that are understandable to the general public.

Throughout the course of BDCP implementation and for the purpose of demonstrating compliance with the provisions of the BDCP, this Agreement, and the associated regulatory authorizations, the Implementation Office shall prepare and submit to the Fish and Wildlife Agencies the following reports.

16.3.1 Annual Progress Report

At the end of each implementation year,[1] the Implementation Office shall begin the preparation of an Annual Progress Report. The report will document the Plan actions carried out during the implementation year and provide information sufficient to demonstrate that the BDCP is being implemented consistent with the provisions of the Plan, this Agreement, and the associated regulatory authorizations. The report will include, as provided for in Chapter 6.3, information relating to the implementation of Conservation Measures, actions taken or changes to Conservation Measures or biological objectives adopted pursuant to the adaptive management and monitoring program, expenditures of funds, occurrences of any Changed Circumstances or unforeseen circumstances, and modifications or amendments to the BDCP or its associated regulatory authorizations. The Annual Progress Report shall also include an evaluation of the progress being made toward meeting the biological goals and objectives of the Plan. The Annual Progress Report shall incorporate the Annual Delta Water Operations Report.

The Program Manager shall solicit input on the draft of the Annual Progress Report from the Permit Oversight Group and the Stakeholder Council, and submit the report to the Authorized Entity Group for review and approval. The Implementation Office shall finalize and submit the Annual Progress Report to the Fish and Wildlife Agencies for their acceptance within six months of the close of the reporting year.

16.3.2 Annual Delta Water Operations Report

Beginning in the first year that the north Delta diversions and conveyance facilities become operational, and for each year thereafter, the Implementation Office shall prepare an Annual Delta Water Operations Report. The report will document the operations of the SWP and the CVP within the Plan Area over the course of the prior implementation year and provide sufficient information to demonstrate that such operations were implemented in a manner consistent with the provisions of the Plan, this Agreement, and the associated regulatory authorizations. The report will include, as described in Chapter 6.3, a summary of the prior year's operations, including a comparison of the actual operations to planned operations, and an evaluation of the effects of water operations on Covered Species and ecological processes, including the responses of those species to real-time operational changes.

The Implementation Office will seek input from the Authorized Entities, Fish and Wildlife Agencies, and the Stakeholder Council on the draft Annual Delta Water Operations Report. Within six months of the close of the reporting year, the Implementation Office shall complete the report and incorporate it into the Annual Progress Report.

16.3.3 Five-Year Comprehensive Review

[1] The Implementation Office will decide how the planning year will be bounded (e.g., calendar year, federal fiscal year, state fiscal year, or water year).

At increments of five years, the Implementation Office shall undertake a Five-Year Comprehensive Review of the BDCP. The purpose of these reviews is to assess, on a periodic, program-level basis, the overall effectiveness of the BDCP, including the progress made toward achieving the biological goals and objectives and water supply reliability targets. As such, these reviews will focus on identifying and evaluating broad ecological trends in the Delta and changes in the status of Covered Species. The scope of the Five-Year Comprehensive Review is described in Chapter 6.3.5.

The Five-Year Comprehensive Review will be carried out by the Implementation Office, in coordination with the Interagency Ecological Program, Delta Science Program, and Independent Science Board. The Implementation Office will work with the Interagency Ecological Program lead scientist and the Delta Science Program Science Manager to consolidate data and information from a range of sources. The Program Manager shall solicit input on the draft findings of the Five-Year Comprehensive Review from the Permit Oversight Group and the Stakeholder Council, and submit the review report to the Authorized Entity Group for review and approval. The Implementation Office shall complete and submit the Five-Year Comprehensive Review report to the Fish and Wildlife Agencies for their acceptance within six months of the close of the five year period subject to the review.

16.4 Inspections by Fish and Wildlife Agencies

The Fish and Wildlife Agencies may conduct inspections and monitoring of the site of any Covered Activity, and may inspect any data or records required by this Agreement, the BDCP or the Permits, in accordance with applicable law and regulations. The USFWS and NMFS may also inspect and monitor the site of any Associated Federal Action for the purpose of verifying Reclamation's compliance with the Integrated Biological Opinion and Incidental Take Statement.

17.0 PLANNING DOCUMENTS

17.1 Purpose of Planning Documents

The Authorized Entities intend for several types of plans to be developed throughout the course of BDCP implementation. Although not a mandatory element of the BDCP, the Parties acknowledge that such plans will improve coordination, enhance the effectiveness of Plan implementation, and increase transparency regarding the administration and implementation of the Plan. Accordingly, the Authorized Entities commit to the development of such plans.

17.2 Types of Planning Documents

17.2.1 Annual Work Plan and Budget

On an annual basis, the Implementation Office will prepare an Annual Work Plan and Budget for the upcoming implementation year. The work plan will describe the activities, including those related to the implementation of Conservation Measures and the Adaptive Management and Monitoring program, which are expected to be implemented. The budget will set out projected expenditures and identify the sources of funding for those expenditures.

The Program Manager shall solicit input on the draft Annual Work Plan and Budget from the Permit Oversight Group and the Stakeholder Council, and submit the Annual Work Plan and Budget to the Authorized Entity Group for review and approval. As part of this process, the Permit Oversight Group will review the draft plan and provide written concurrence, within thirty (30) days, or as soon as practicable thereafter, that the draft plan accurately sets forth and makes adequate provision for the implementation of the applicable joint decisions of the Authorized Entity Group and the Permit Oversight Group or decisions of an agency with authority over the matter.

If the Permit Oversight Group concludes that the draft plan does not do so, it will provide written notification to the Program Manager and the Authorized Entity Group, within the 30 day timeframe, or as soon as practicable thereafter, of the specific reasons for its conclusion. In such event, the Authorized Entity Group may direct the Program Manager to modify the draft plan to the satisfaction of the Permit Oversight Group. If the Authorized Entity Group does not, the Program Manager, Authorized Entity Group and the Permit Oversight Group will, in a timely manner, meet and confer in an effort to resolve the matter in dispute. If the Parties are unable to reach resolution, the review process described in Chapter 7.1.7 and Section 15.8 of this Agreement may be invoked by any member of the Authorized Entity Group or the Permit Oversight Group.

The draft Annual Work Plan and Budget will be submitted for review and comments to the Authorized Entity Group no later than three months, and the Permit Oversight Group and the Stakeholder Council no later than two months, prior to the release of the final Annual Work Plan and Budget. A final Annual Work Plan and Budget will be completed no later than one month prior to the beginning of the implementation year. The Program Manager will utilize the foregoing process with respect to any proposed amendments to the Annual Work Plan and Budget.

17.2.2 Annual Delta Water Operations Plan

On an annual basis, DWR and Reclamation will jointly develop an Annual Delta Water Operations Plan. The Annual Delta Water Operations Plan will set out the operational priorities and strategies to address biological objectives and water supply targets for the upcoming year, and include other information as set forth in Chapter 6.3. The first of such plans will be prepared in the year prior to the initiation of operations of the north Delta diversion and conveyance facilities (assumed to be year nine). Subsequent plans will be prepared and finalized no later than one month prior to each implementation year.

DWR and Reclamation will seek input from other members of the Authorized Entity Group, the Implementation Office, Permit Oversight Group, Adaptive Management Team, and the Stakeholder Council regarding the draft Annual Delta Water Operations Plan. The Annual Delta Water Operations Plan will include: 1) operational priorities for both fisheries and water supply for the upcoming year for the purpose of maximizing conservation benefits to covered fish species and maximizing water supplies; 2) expected operations, including consideration of real time operational adjustments, consistent with the criteria established in CM1 and CM2; 3) monitoring, data collection, research efforts, and potential adaptive management actions associated with water operations for the upcoming year and 4) the potential need for the Supplemental Resources Fund to assist in achieving the overall goals of the BDCP for the coming year due to anticipated operating conditions. DWR and Reclamation will retain final approval authority over the plan; however, the Permit Oversight Group will, within thirty (30) days of receipt of the draft plan, or as soon as practicable thereafter, review the draft plan and provide written concurrence that the draft plan is consistent with the provisions of the BDCP, this Agreement, and the associated regulatory authorizations.

If the Permit Oversight Group concludes that the draft plan is not consistent, it will notify DWR and Reclamation in writing within the 30-day timeframe, or as soon as practicable thereafter, of the specific reasons for its conclusion. In such event, DWR and Reclamation may modify the plan to the satisfaction of the Permit Oversight Group. If they do not, DWR, Reclamation and the Permit Oversight Group will, in a timely manner, meet and confer in an effort to resolve the matter in dispute. If these Parties are unable to reach resolution, the review process in Chapter 7.1.7 and Section 15.8 of this Agreement may be invoked by any of these parties. In the event that the Permit Oversight Group invokes the elevation process, DWR and Reclamation may nonetheless begin to implement the plan, provided that their operations do not substantially preclude a potential resolution of the issue in dispute. The Implementation Office will incorporate the final Annual Delta Water Operations Plan into the Annual Work Plan and Budget (Chapter 6.3).

17.2.3 Five-Year Implementation Plan

Based on the Five-Year Comprehensive Review, the Implementation Office will prepare a Five-Year Implementation Plan that identifies and assesses prospective issues likely to arise over the upcoming five-year period. The Five-Year Implementation Plan will contain, among other things, a summary of the planned actions and timeframe for those actions, including potential revisions to those actions and timeframes, related to the implementation of the Conservation Strategy; a description of expected long-term and system-wide monitoring actions and anticipated research efforts; and budget projections reflecting the estimated costs of implementing future actions.

The Program Manager shall solicit input on the draft Five-Year Implementation Plan from the Permit Oversight Group and the Stakeholder Council, and submit the draft plan to the Authorized Entity Group for review and approval. As part of this process, the

Permit Oversight Group will review the draft plan and provide written concurrence, within thirty (30) days, or as soon as practicable thereafter, that the draft plan accurately sets forth and makes adequate provision for the implementation of the applicable joint decisions of the Authorized Entity Group and the Permit Oversight Group or decisions of an agency with authority over the matter.

In years when Five-Year Implementation Plans are prepared, the Annual Work Plan and Budget may be included with or prepared separately from the Five-Year Implementation Plan.

18.0 RELATIONSHIP OF THE BDCP TO OTHER REGIONAL CONSERVATION PLANS

The Plan Area adjoins or overlaps with six other regional conservation plans that are being implemented or are under development. The Parties expect that implementation of the BDCP will not adversely affect or be incompatible with overlapping and adjoining plans that have been approved or are under development. To ensure the successful implementation of the BDCP and these other regional conservation plans, the Implementation Office will undertake the following efforts:

- Encourage local government participation on the Stakeholder Council.

- Establish processes to enhance opportunities for collaboration and coordination between the Implementation Office and the regional plan sponsors on matters relating to, among other things, the acquisition and management of lands preserved as habitat within areas common to both plans.

- Enlist local governments to serve as Supporting Entities to assist in the acquisition and management of habitat lands.

- Encourage joint acquisitions of land to realize economies of scale and to secure large, contiguous blocks of habitat.

- Explore opportunities to identify the range of easement values serving one or more conservation objectives of the BDCP and other regional plans.

- Identify key acquisition areas that meet the full complement of conservation objectives (e.g., intrinsic habitat value, connectivity, reducing exposure to the effects of climate change) and that may be available for support of existing plans in conjunction with the BDCP.

- Explore opportunities for the Implementation Office to facilitate funding for “advance” conservation actions (i.e., habitat acquisition and

restoration) that may benefit both the BDCP and other regional conservation plans.

- Work with the sponsors of the regional conservation plans in California to encourage an increase in federal appropriations to support HCP implementation through existing federal grant programs and to help ensure that sufficient funds are available to all eligible plans in California.

19.0 RELATIONSHIP OF THE BDCP TO THE DELTA PLAN

The Sacramento–San Joaquin Delta Reform Act of 2009 (Act) (Water Code §§ 85300 *et seq*.), provides for the establishment of an independent State agency, the Delta Stewardship Council, which is charged with the development and implementation of a comprehensive Delta Plan, and is vested with the authority to review actions of State and local agencies and advise on their consistency with the Delta Plan.

The Act sets out conditions for the inclusion of the BDCP into the Delta Plan. To ensure that the BDCP is incorporated into the Delta Plan in a timely manner, CDFW, upon execution of this Agreement and issuance of Permits, shall immediately notify the Delta Stewardship Council that the BDCP meets the requirements of the NCCPA. USFWS and NMFS shall similarly provide timely notification to the Delta Stewardship Council that the BDCP has been permitted under ESA Section (10)(a)(1)(B).

20.0 SPECIFIC OBLIGATIONS OF THE FISH AND WILDLIFE AGENCIES

20.1 Obligations of USFWS and NMFS

20.1.1 Future Section 7 Consultations for Covered Activities and Associated Federal Actions

The BDCP is intended to meet the requirements of the ESA and provide the basis for regulatory coverage for a range of activities identified in the Plan. Some of the Covered Activities and Associated Federal Actions may require funding or regulatory authorizations or approvals from other federal agencies. In such instances, these federal agencies may need to consult with USFWS and/or NMFS under Section 7 of the ESA with respect to the effect of the activity on listed species and critical habitat.

Unless otherwise required by law or regulation, in any future Section 7 consultation on a Covered Activity or Associated Federal Action, USFWS and NMFS will each ensure that the Section 7 consultation(s) is(are) consistent with the Integrated Biological Opinion provided that the action as proposed in the consultation is consistent, and will be implemented in accordance with the Plan, and this Agreement. Unless otherwise required by law or regulation, USFWS and NMFS will not require through the Section 7 consultation additional land, water or other natural resources, or financial compensation

or additional restrictions on the use of land, water, or other natural resources for Covered Activities and Associated Federal Actions beyond the measures provided for under the BDCP, the Implementing Agreement, the Permits, and the Integrated Biological Opinion.

20.1.2 Section 7 Consultations for Other Activities

In any Section 7 consultation that occurs subsequent to the issuance of take authorizations under the BDCP and involves actions other than Covered Activities and Associated Federal Actions that may have an effect upon Covered Species and their habitats within the Plan Area, USFWS and NMFS shall give notice thereof to the Authorized Entities, Implementation Office, and the Authorized Entity Group. For these biological opinions issued in connection with projects that are independent of the Covered Activities and Associated Federal Actions, USFWS and NMFS agree to make every effort to avoid rendering opinions or taking actions that would cause additional restrictions on the use of land, money, or water for the Authorized Entities with respect to their obligations under the BDCP or this Agreement.

20.1.3 Reinitiation of Consultation on Integrated Biological Opinion

The Parties acknowledge that circumstances may arise under which Reclamation and USFWS and NMFS determine that it is necessary to reinitiate Section 7 consultation with regard to the Integrated Biological Opinion. Reinitiation of Section 7 consultation on the Integrated Biological Opinion shall occur in accordance with the criteria set forth at 50 C.F.R. § 402.16. The Parties agree the BDCP includes provisions that provide for adjustments to Conservation Measures and Plan implementation through adaptive management and through planned responses to Changed Circumstances if new information reveals the Covered Activities and Associated Federal Actions may affect Covered Species in a manner or to an extent not previously considered. Therefore, Reclamation, USFWS and NMFS will not re-initiate consultation on the Integrated Biological Opinion without first evaluating the BDCP provisions that provide for a response to these newly identified effects, and making a determination that the BDCP provisions are not sufficient to address those effects. Prior to any reinitiation of consultation regarding the Integrated Biological Opinion, the Authorized Entities and USFWS and NMFS shall meet and confer and attempt to resolve any disagreements regarding whether such reinitiation of consultation is warranted.

20.1.4 Reinitiation of Consultation on Other CVP/SWP-Related Biological Opinions

Prior to the reinitiation of consultation regarding a biological opinion involving CVP or coordinated CVP/SWP operations other than those addressed in the BDCP and the Integrated Biological Opinion, the Authorized Entities and USFWS and NMFS will meet and confer regarding any disagreements over the need to reinitiate consultation If Reclamation or FWS and/or NMFS reinitiates consultation on a Biological Opinion involving CVP or coordinated CVP/SWP operations, to the maximum extent allowed by

law, Reclamation will prepare the Biological Assessment and the USFWS and/or NMFS, as applicable, will prepare the Biological Opinion consistent with the BDCP, the permits, the Integrated Biological Opinion and this Agreement including the Assurances and Protections.

20.1.5 Process for Review of Draft Biological Assessments and Draft Biological Opinions Prepared During Reinitiation of Consultation on the Integrated Biological Opinion or Other CVP/SWR-Related Biological Opinions

In the event of reinitiation of consultation on actions addressed in the Integrated Biological Opinion or on actions related to the CVP operations or coordinated CVP/SWP operations that may substantially affect the BDCP , the Permittees, as well as other affected parties as determined by the action agency, shall be given the opportunity to participate, within the timeframes required by the action agency, in such consultation, and allowed to (i) submit information for consideration during consultation, (ii) review and comment on draft biological assessments and draft biological opinions prepared for such consultation, and, (iii) participate in the development of reasonable and prudent alternatives that would substantially affect BDCP, in the event a jeopardy or adverse modification determination is made.

20.1.6 Critical Habitat Designation for Covered Species

The BDCP and this Agreement provide a comprehensive, habitat-based approach to the protection of Covered Species by focusing on the land and water necessary to provide for the long-term conservation and management of the Covered Species. This approach is consistent with the overall purposes of the ESA to provide a means whereby the ecosystems upon which endangered and threatened species depend may be conserved.
At the time critical habitat is considered for a species proposed for listing under the ESA or currently listed under the ESA, the Services will consider whether habitat protections under the BDCP adequately protect habitat that would be deemed essential to the species' recovery and survival. If the finding is that the habitat is adequately protected, and the benefits of exclusion outweigh the benefits of inclusion, such critical habitat would not be designated in BDCP Plan Area. If critical habitat is designated within the BDCP Plan Area subsequent to issuance of the permits, no compensation, mitigation, or minimization measures will be required of the Permittees as a result of the designation.

20.1.7 Future Recovery Plans for Covered Species

Recovery plans under the ESA delineate actions necessary to recover and protect federally listed species. During the preparation of the BDCP, these plans provided useful information and recommendations that informed the development of the Conservation Strategy. Recovery plans are not, however, intended to establish or define the obligations of permit applicants under the ESA.

The Parties acknowledge that ESA recovery plans have no effect on the implementation of the BDCP, except to the extent that they may contribute information that supports the Adaptive Management and Monitoring Program. With respect to any recovery plan applicable to any Covered Species within the Plan Area that is developed after the approval of the BDCP the parties agree that:

- Recovery plans cannot require any additional land or financial compensation or otherwise diminish the take authorization for Covered Species granted to the Authorized Entities pursuant to the Federal Permits or the Integrated Biological Opinion.

- Be finalized only after USFWS and NMFS will provide an opportunity for input from the Authorized Entity Group on the draft recovery plan.

20.1.8 Agencies Responsible for Conducting the NEPA Analysis

Reclamation, USFWS, and NMFS have served as federal lead agencies under NEPA regarding the preparation of the joint EIR/Environmental Impact Statement (EIS) for the BDCP. Prior to the Effective Date, the lead agencies prepared an EIS that fully analyzed the actions proposed in the BDCP and a full range of alternatives to ensure that decision makers and the public were fully informed of the potentially significant effects of the proposed BDCP, and the alternatives to the Plan, on the quality of the human environment.

20.1.9 Future Environmental Review Under NEPA

To the maximum extent possible in accordance with NEPA and applicable law, Reclamation, USFWS, and NMFS shall rely on and use relevant portions of the EIS and NEPA findings when conducting future environmental review of Covered Activities and Associated Federal Actions. In the event that USFWS or NMFS participate as a lead or cooperating agency under NEPA with respect to subsequent environmental review related to the implementation of a Covered Activity or Associated Federal Action, USFWS or NMFS will not recommend or request the imposition of any additional or more stringent minimization or mitigation measures related to the protection or conservation of Covered Species or their habitat unless required by applicable law. Except in those instances, USFWS and NMFS will notify the lead NEPA agency that the Conservation Measures in the BDCP fully address any impact to or incidental take of any Covered Species or habitat resulting from Covered Activities or Associated Federal Actions.

20.2 Obligations of CDFW

20.2.1 CEQA

20.2.1.1 Agencies Responsible for CEQA Analysis

CDFW has served as a responsible agency under CEQA regarding the development of the joint EIR/EIS for the BDCP. Prior to or concurrent with the Effective Date, DWR and CDFW each evaluated the BDCP pursuant to CEQA and issued findings addressing whether the implementation of the BDCP would cause significant adverse impacts to the environment.

20.2.1.2 Future Environmental Review Under CEQA

Unless otherwise required by CEQA or other applicable law, the Permittees and CDFW shall rely on and use relevant portions of the EIS/EIR and the CEQA findings when conducting future environmental review of Covered Activities. In the event that CDFW participates as a lead, responsible, or trustee agency under CEQA with respect to the implementation of Covered Activities, CDFW will not require, recommend, or request the imposition of any additional or more stringent minimization or mitigation measures directed at the protection or conservation of Covered Species or their habitats. As a responsible or trustee agency under CEQA, CDFW will further notify the lead CEQA agency that any avoidance, minimization, and mitigation measures otherwise required for any impact to or take of any Covered Species or habitat resulting from Covered Activities will be satisfied through the implementation of the BDCP.

20.2.2 Lake and Streambed Alteration Agreements for Covered Activities

CDFW acknowledges and agrees that the BDCP, this Agreement, and the State Permit shall be deemed to provide an equivalent level of protection for wildlife, habitat, or other biological resources as the measures that would otherwise be required or recommended to address the impacts of Covered Activities on Covered Species pursuant to Fish & Game Code §§ 1600–1616.

In any future notification provided to CDFW under Section 1602 related to a Covered Activity, CDFW will ensure that any Streambed Alteration Agreement issued in response to the notification is consistent with the BDCP, this Agreement, and the State Permit. Unless otherwise required by law or regulation, CDFW will not require through the Streambed Alteration Agreement additional land, water or other natural resources, or financial compensation or additional restrictions on the use of land, water, or other natural resources to address impacts of Covered Activities on Covered Species beyond the measures provided for under the BDCP, this Agreement, and the State Permit.

21.0 TERM

21.1 Effective Date

This Agreement shall be effective upon execution by all Parties and issuance of all Permits.

21.2 Term of the Permits

The Permits will be in effect for a term of fifty (50) years, unless extended pursuant to Section 21.3. The terms of the Permits will begin from the Effective Date.

21.3 Extension of Permit Duration

Prior to expiration of the Permits, the Permittees may apply to the Fish and Wildlife Agencies to renew the Permits. The Permittees will initiate the Permit renewal process prior to the expiration of the initial 50-year period and with sufficient time to allow for the review and processing of the Permit renewal.

21.4 Withdrawal

Upon ninety (90) days written notice to the Parties, any Permittee may unilaterally withdraw from the BDCP and this Agreement. Such withdrawal of a Permittee from this Agreement shall be deemed to constitute a surrender of the Permittee's authorization under the Permits. In the event of withdrawal by any Permittee other than DWR, the remaining Permittees would remain obligated to meet all Permittee requirements under the Plan and this Agreement. In the event of withdrawal by DWR, the Permits will be terminated.

21.4.1 Obligations in the Event of Withdrawal

As a condition of withdrawal, the withdrawing Party(ies) shall remain obligated to ensure implementation of all existing and outstanding Conservation Measures required under this Agreement, the BDCP and the Permits to address all impacts of any take caused by the withdrawing Party(ies) that occurred prior to such withdrawal. Such obligations would include long-term management of Reserve Lands established prior to withdrawal.

21.4.2 Mitigation Credit in the Event of Withdrawal

In the event of withdrawal, the withdrawing Party(ies) shall receive mitigation credit for any mitigation attributable to the withdrawing Party(ies) that occurs prior to withdrawal and that is not required to offset take that occurred prior to withdrawal.

22.0 REMEDIES AND COMPLIANCE

Each Party will have all of the remedies available in equity (including specific performance and injunctive relief) and at law to enforce the terms of this Agreement, the BDCP and the Permits, and to seek redress for any breach or violation thereof; except to the extent that equitable relief in contract (including specific performance) is not available against the United States, and except that:

- none of the Parties will be liable in damages to any other Party or to any other person or entity for any breach of this Agreement, any performance or failure to perform a mandatory or discretionary obligation imposed by this Agreement, or any other cause of action arising from this Agreement;

- in the event that the Authorized Entities are wholly or partially prevented from performing obligations under this Agreement because of causes beyond their reasonable control and without their fault or negligence (force majeure), including, but not limited to, acts of God, labor disputes, sudden actions of the elements not identified as Changed Circumstances, or actions of non-participating federal or State agencies or local jurisdictions, the Authorized Entities, as applicable, will be excused from whatever performance is affected by such cause to the extent so affected, and such failure to perform will not be considered a material violation or breach, provided that nothing in this Section will be deemed to authorize any Authorized Entities to violate the ESA, CESA or NCCPA, and provided further that:

    - The suspension of performance is of no greater scope and no longer duration than is required by the force majeure;

    - Within fifteen (15) days after the occurrence of the force majeure, the Authorized Entities, as applicable, provide the Fish and Wildlife Agencies written notice describing the particulars of the occurrence;

    - The Authorized Entities use their best efforts to remedy their inability to; and

    - When the Authorized Entities are able to resume performance of their obligations, the Authorized Entities, as applicable, shall give the Fish and Wildlife Agencies written notice to that effect.

Nothing in this Agreement is intended to limit the authority of the federal and State government to seek civil or criminal penalties, equitable relief, or otherwise fulfill enforcement responsibilities under the ESA, NCCPA or other applicable law.

22.1 Suspension of Federal Permits

USFWS or NMFS may suspend the Federal Permits, in whole or in part, for cause in accordance with 50 C.F.R. § 13.27 and 222.306(e) and other applicable laws and regulations in force at the time of such suspension. Unless emergency suspension is necessary to avoid jeopardy to a Covered Species, USFWS or NMFS shall not issue a notice of proposed suspension in accordance with 50 C.F.R. § 13.27(b) without first (1) attempting to resolve, in accordance with Section 15.8, any disagreements regarding the implementation or interpretation of the BDCP, this Agreement or the Permits; and (2)

identifying the facts or conduct which may warrant the suspension and requesting the Implementation Office to take appropriate remedial actions. Unless emergency suspension is necessary, USFWS and NMFS shall not suspend a Federal Permit, in whole or in part, to avoid the likelihood of jeopardy to a Covered Species, without first following the dispute resolution process in Section 22.5 of this Agreement. Any proposed decision to suspend the USFWS permit must be reviewed and approved in writing by the Assistant Secretary for Water and Science and the Assistant Secretary for Fish Wildlife and Parks, before it is effective. Any proposed decision to suspend the NMFS permit must be reviewed and approved in writing by the appropriate Under Secretary at the Department of Commerce. This responsibility shall not be delegated.

22.2 Reinstatement of Suspended Federal Permits

In the event USFWS or NMFS suspends a Federal Permit, in whole or in part, as soon as possible but no later than ten (10) days after such suspension, USFWS or NMFS, as applicable, will meet and confer with the Implementation Office concerning how the suspension can be ended. At the conclusion of any such conference, USFWS or NMFS will identify reasonable, specific actions, if any, necessary to effectively redress the suspension. In making this determination, USFWS or NMFS will consider the requirements of the ESA and its regulations, the conservation needs of the Covered Species, the terms of the Federal Permit and of this Agreement and any comments or recommendations received from the Implementation Office. As soon as possible, but not later than thirty (30) days after the conference, USFWS/NMFS will send the Implementation Office written notice of any available, reasonable actions necessary to effectively redress the deficiencies giving rise to the suspension. Upon performance or completion, as appropriate, of such actions, USFWS/NMFS will immediately reinstate the Federal Permit. It is the intent of the Parties that in the event of any total or partial suspension of a Federal Permit, all Parties will act expeditiously and cooperatively to reinstate the Federal Permit.

22.3 Revocation of Federal Permits

USFWS and NMFS each agree that it will not revoke or terminate a Federal Permit, in whole or in part, pursuant to 50 C.F.R. §§ 13.28–13.29 and 50 C.F.R. §§ 17.22(b)(8) and 17.32(b)(8) unless the Permittees fail to fulfill their obligations under the BDCP, this Agreement, or the Federal Permits, and only after identifying the facts or conduct which may warrant the revocation and requesting the Implementation Office to take appropriate remedial actions, and following the review process in Section 15.8 if invoked by a Permittee, unless immediate revocation is necessary to avoid the likelihood of jeopardy to a Covered Species. USFWS and NMFS each agree that it will not revoke or terminate a Federal Permit, in whole or in part, to avoid the likelihood of jeopardy to a Covered Species, without first following the dispute resolution process in Section 22.5 of this Agreement.

Any proposed decision to revoke the USFWS permit must be reviewed and approved in writing by the Assistant Secretary for Water and Science and the Assistant Secretary for Fish Wildlife and Parks, before it is effective. Any proposed decision to revoke the NMFS permit must be reviewed and approved in writing by the appropriate Under Secretary at the Department of Commerce. This responsibility shall not be delegated.

22.4 Suspension or Revocation of the State Permit

CDFW may suspend or revoke, in whole or in part, the State Permit in the event that it determines that the Permittees have failed to fulfill their obligations under the BDCP, this Agreement, or the State Permit. Unless an immediate suspension is necessary to avoid jeopardy, CDFW shall not suspend or revoke the State Permit without first notifying in writing the Implementation Office and Permittees of the basis for its determination and the proposed action to revoke or suspend and meeting and conferring with the Program Manager and the Permittees regarding the matter. The Parties shall meet and confer within fifteen (15) days of issuance of such notice to assess the action or inaction that warranted CDFW's determination and to identify any appropriate responsive measures that may be taken. Within forty-five (45) days of receiving notice from CDFW, Permittees shall either satisfy CDFW that they are in compliance with the State Permit or reach an agreement with CDFW to expeditiously obtain compliance.

Following this forty-five (45) day period, CDFW may suspend, but shall not revoke the State Permit until such time as the review process set forth in Section 15.8 of this Agreement has been completed, provided the process has been invoked by a Permittee. Any decision to suspend or revoke the State Permit must be in writing and must be signed by the Director of CDFW. This responsibility shall not be delegated. Situations related to a jeopardy determination are addressed under Section 22.6 of this Agreement.

22.5 Dispute Resolution Process for Revocation or Suspension of the Federal Permits or Invalidation of the Incidental Take Statement Related to a Jeopardy Determination

In the event that USFWS or NMFS determine, after following the process to address unforeseen circumstances set forth in Section 14.3.3 of this Agreement, that circumstances warrant suspension or revocation of one or both of the Federal Permits or invalidation of the Incidental Take Statement to avoid jeopardy to a Covered Species, USFWS and/or NMFS, as applicable, shall meet and confer with the Program Manager and the Authorized Entity Group within thirty (30) days of such determination to identify potential actions that may be available to forestall the suspension or revocation. Such actions that may include, but would not be limited to, the following:

- Identify and secure other State and/or federal resources that had not been previously identified.

- Identify voluntary implementation actions that the Authorized Entities may undertake to remedy the situation. Such measures may include (1) adjustments of project operations to reduce or avoid impacts; (2) operational changes at the points of diversions; (3) water transfers or purchase of water rights involving third parties; (4) new water storage or banking arrangements; (5) payments from the federal and State governments to the Authorized Entities for reduced allocations; and (6) additional funding for wildlife agency staff to increase enforcement against third party activities causing unlawful take.

If no such remedies are identified, and USFWS and/or NMFS determine that the continuation of a Covered Activity or Associated Federal Action will result in jeopardy to a Covered Species, any member of the Authorized Entity Group may invoke the review process in Section 15.8 of this Agreement.

22.6 Dispute Resolution Process for Revocation or Suspension of the State Permit Related to a Jeopardy Determination

Section 2823 of the NCCPA provides that CDFW shall suspend or revoke any permit, in whole or in part, issued for the take of a species subject to Section 2835 if the continued take of the species would result in jeopardizing the continued existence of the species. CDFW agrees that it will not revoke the State Permit pursuant to Section 2823 without first (a) requesting that the Permittees take appropriate remedial action, and (b) providing the Permittees with notice in writing of the facts or conduct which warrant the revocation and a reasonable opportunity (but not less than forty-five (45) days) to take remedial action. CDFW shall meet and confer with the Program Manager and the Permittees within fifteen (15) days of such notice to identify potential actions that may be available to forestall the revocation. Such actions may include, but would not be limited to, the following:

- Identify and secure other State and/or federal resources that had not been previously identified.

- Identify voluntary implementation actions that the Permittees may undertake to remedy the situation. Such measures may include (1) adjustments of project operations to reduce or avoid impacts; (2) operational changes at the points of diversions; (3) water transfers or purchase of water rights involving third parties; (4) new water storage or banking arrangements; (5) payments from the federal and State governments to the Authorized Entities for reduced allocations; and (6) additional funding for wildlife agency staff to increase enforcement against third party activities causing unlawful take.

If no such remedies are identified, and CDFW determines that continued take of a Covered Species would result in jeopardizing the continued existence of the species, CDFW shall suspend or revoke the State Permit, in whole or in part, under Fish & Game Code Section 2823. CDFW shall not revoke the State Permit, however, until such time as the review process set forth in Section 15.8 of this Agreement has been completed, provided the process has been invoked by a Permittee.

22.7 Obligations in the Event of Permit Suspension or Revocation

In the event of suspension or revocation of the Permits, the Permittees will remain obligated to fulfill any existing and outstanding minimization and mitigation measures required of them under this Agreement or the BDCP related to any Take that occurs prior to such suspension, revocation, or termination. Such obligations would include the obligation to provide for the long-term management or Reserve System Lands that were established prior to suspension or termination of the Permits or that would otherwise be required under the Plan for impacts of any act that would cause the permitted Take.

23.0 MODIFICATIONS AND AMENDMENTS

The BDCP may be modified during implementation in accordance with CDFW, USFWS, and NMFS regulations, the Plan, and the terms of this Agreement. Plan modifications may be needed periodically to clarify provisions or correct unanticipated inconsistencies in the documents. Plan changes fall into three broad categories: administrative changes, minor modifications, and formal amendments. Certain changes to the BDCP will also require an amendment to the Permits.

23.1 BDCP Administrative Changes

The administration and implementation of the BDCP will require frequent and ongoing interpretation of its provisions by the Implementation Office and the Parties. Actions taken on the basis of these interpretations that do not substantively change the purpose, intent, or terms of the Plan or this Agreement will not require modification or amendment of the Plan, this Agreement, or its associated authorizations. Such actions related to the ordinary administration and implementation of the Plan may include, but are not limited to, the following:

- Clerical corrections to typographical, grammatical, and similar editing errors that do not change the intended meaning; or to maps or other exhibits to address insignificant errors.

- Variations in the day-to-day management of reserve system lands.

- Adjustments to monitoring protocols to incorporate new protocols approved by the Fish and Wildlife Agencies.

- Administration of the Implementation Office.

- Changes in the representatives of member entities of the Stakeholder Council.

- Minor corrections to land ownership descriptions.

- Changes to survey, monitoring, reporting, restoration, and/or management protocols or techniques that do not adversely affect Covered Species or habitat functions and values.

- Updates or corrections to the land cover or other resource maps or species occurrence data.

23.2 Minor Modifications or Revisions

As part of the process of Plan implementation, the Implementation Office may need to make minor modifications or revisions to the Plan and/or this Agreement from time to time to respond appropriately to new information, scientific understanding, technological advances, and other such circumstances. Minor modifications or revisions are likely to be technical in nature and will not involve changes that will adversely affect Covered Species, the level of take, or the obligations of Authorized Entities.

Minor modifications or revisions may include, but are not limited to, the following circumstances:

- Transfers of targeted acreages between Resource Opportunity Areas consistent with criteria set out in Chapter 3.

- Transfers of targeted natural community acreages among Conservation Zones, provided such change does not preclude meeting preserve assembly requirements, significantly increase the cost of Plan management, or preclude achieving biological goals and objectives.

- Adjustments of Conservation Measures or biological objectives developed through and consistent with the adaptive management program, as described in Chapter 3.6.

- Extensions of earth-moving or ground disturbance outside the right-of-way limits analyzed in the effects analysis for the Plan regarding Covered

Activities and Associated Federal Actions involving infrastructure development or natural community restoration.

- Other proposed changes to the Plan that the Fish and Wildlife Agencies have determined to be insubstantial and appropriate for implementation as a minor modification.

23.2.1 Procedures for Minor Modifications

The Implementation Office, the Authorized Entities, or the Fish and Wildlife Agencies may propose minor modifications or revisions by providing written notice to the other Parties. Such notice will include a description of the proposed minor modifications or revisions, an explanation of the reason for the proposed minor modifications or revisions, an analysis of their environmental effects including any impacts on Covered Species, and an explanation of why the effects of the proposed minor modifications or revisions will have the following characteristics.

- They will not significantly differ from, and will be biologically equivalent or superior to, the effects described in the Plan.

- They will not conflict with the terms and conditions of the Plan.

- They will not significantly impair implementation of the Conservation Strategy.

The Fish and Wildlife Agencies and/or the Authorized Entities may submit comments on the proposed minor modification or revision in writing within sixty (60) days of receipt of notice. The Authorized Entities must agree to any proposed minor modification.

If the Fish and Wildlife Agencies do not concur that the proposed minor modification or revision meets the requirements for a minor modification or revision, the proposal must be processed as a formal amendment as described in Section 23.3. Any Authorized Entity or Fish and Wildlife Agency may invoke the review process set forth in Section 15.8 of this Agreement to resolve disagreements concerning a proposed minor modification or revision.

If the Fish and Wildlife Agencies concur that the requirements for a minor modification or revision have been met and the modification or revision should be incorporated into the Plan, the BDCP shall be modified accordingly. If any Fish and Wildlife Agency fails to respond to the written notice within the 60-day period, the agency will be deemed to have approved the proposed minor modification or revision.

Notwithstanding the foregoing, agreement of the Authorized Entities shall not be required for minor modifications that involve changes to Conservation Measures or biological

objectives adopted through the adaptive management process, as described in Chapter 3.6.

23.3 Formal Amendment

Under some circumstances, it may be necessary to substantially amend the Plan and this Agreement. Any proposed changes to the Plan that do not qualify for treatment as described in Chapters 6.5.1 or 6.5.2 will require a formal amendment. Formal amendment to the Plan and this Agreement also will require corresponding amendment to the authorizations/Permits, in accordance with applicable laws and regulations regarding permit amendments. The Implementation Office will be responsible for submitting any proposed amendments to the Permit Oversight Group.

Amendments to the Plan likely will occur infrequently and will follow the process set forth in Chapter 6.5.3. Formal amendments include, but are not limited to, the following changes.

- Substantive changes to the boundary of the Plan Area, other than those associated with the acquisition of terrestrial natural communities in the surrounding Delta counties, as described in Chapter 1.4.1.
- Addition of species to the Covered Species list.
- Increase in the take of Covered Species beyond that authorized.
- Adding new Covered Activities and Associated Federal Actions to the Plan.
- Substantial changes in implementation schedules that are likely to have significant adverse effects on the Covered Species.
- Changes in Conservation Measures that would require additional obligations of the Authorized Entities beyond those provided for within the adaptive resources established under the Plan and this Agreement.
- Changes to Biological Goals.

23.3.1 Process for Formal Amendment

Formal amendments will involve the same process that was required for the original approval of the Plan. In most cases, an amendment will require public review and comment, CEQA and NEPA compliance, and intra-Service Section 7 consultation. Amendments will be prepared by the Implementation Office, subject to review and approval of the Authorized Entity Group prior to submission to the Permit Oversight Group. Each Fish and Wildlife Agency, for which the proposed amendment is

applicable, will use reasonable efforts to process proposed amendments within one-hundred eighty (180) days.

23.3.2 Additions to Covered Species List

In the event the Authorized Entities desire to add species to the list of Covered Species, the Authorized Entities will propose an amendment to the BDCP and request an amendment to the Permits and the Integrated Biological Opinion. Any such request will be supported by sufficient evidence to meet the requirements of the ESA and the NCCPA. The Fish and Wildlife Agencies shall give due consideration to, and full credit for, Conservation Measures previously implemented as part of the Plan that benefit such species.

24.0 MISCELLANEOUS PROVISIONS

24.1 No Delegation of Authority

Nothing in this Agreement shall cause, or shall be deemed to cause, any delegation of authority from any Party to this Agreement to any other Party.

24.2 Relationship to Other Regulatory Requirements

The terms of this Agreement are consistent with and will be governed by and construed in accordance with the ESA, the NCCPA and other applicable State and federal laws. In particular, nothing in this Agreement is intended to limit the authority of USFWS, NMFS and CDFW to seek penalties for violations of, or otherwise fulfill its responsibilities under, the ESA, CESA and NCCPA. Moreover, nothing in this Agreement is intended to limit or diminish the legal obligations and responsibilities of USFWS or NMFS as agencies of the federal government or CDFW as an agency of the State of California.

24.3 Changes in Environmental Laws

It is acknowledged and agreed by the Fish and Wildlife Agencies that the Authorized Entities are agreeing to perform substantial avoidance, minimization, mitigation, conservation, and management measures as set forth in this Agreement. If a change in, or an addition to, any federal or State law governing or regulating the impacts of development on land, water or biological resources as they relate to Covered Species, including, but not limited to, the ESA, NEPA, NCCPA, CESA, and CEQA, the Fish and Wildlife Agencies shall give due consideration to the measures required under the BDCP in applying the new laws and regulations to the Authorized Entities.

24.4 References to Regulations

Any reference in this Agreement, the BDCP, or the Permits to any regulation or rule of the Fish and Wildlife Agencies will be deemed to be a reference to such regulation or rule in existence at the time an action is taken.

24.5 Applicable Laws

All activities undertaken pursuant to this Agreement, the BDCP, or the Permits must be in compliance with all applicable local, State and federal laws and regulations.

24.6 Notices

The Implementation Office will maintain a list of individuals responsible for ensuring BDCP compliance for each of the Parties, along with addresses at which those individuals may be notified (Notice List). The Notice List as of the Effective Date is provided in Exhibit G. Each Party will report any changes of names or addresses to the Implementation Office and the other Parties in writing.

Any notice permitted or required by this Agreement will be in writing, and delivered personally, by overnight mail, or by United States mail, postage prepaid. Notices may be delivered by facsimile or electronic mail, provided they are also delivered by one of the means listed above. Delivery will be to the name and address of the individual responsible for each of the Parties, as stated on the most current Notice List.

Notices will be transmitted so that they are received within deadlines specified in this Agreement, where any such deadlines are specified. Notices delivered personally will be deemed received on the date they are delivered. Notices delivered via overnight delivery will be deemed received on the next business day after deposit with the overnight mail delivery service. Notices delivered via non-certified mail will be deemed received seven (7) days after deposit in the United States mail. Notices delivered by facsimile or other electronic means will be deemed received on the date they are received.

24.7 Entire Agreement

This Agreement, together with the BDCP, the Permits, the Integrated Biological Opinion, and the Memorandum, constitutes the entire agreement among the Parties, supersedes any and all other agreements, either oral or in writing, among the Parties with respect to the subject matter hereof, and contains all of the covenants and agreements among them with respect to said matters. Each Party acknowledges that no representation, inducement, promise of agreement, oral or otherwise, has been made by any other Party or anyone acting on behalf of any other Party that is not embodied in this Agreement, the BDCP, the Permits, the Integrated Biological Opinion, or the Memorandum.

24.8 Severability

In the event one or more of the provisions contained in this Agreement is held to be invalid, illegal or unenforceable by any court of competent jurisdiction, the Parties will meet and confer to determine whether such portion will be deemed severed from this Agreement and the remaining parts of this Agreement will remain in full force and effect as though such invalid, illegal, or unenforceable portion had never been a part of this Agreement.

24.9 Independent State and Federal Permits

The State and Federal Permits are independent such that revocation of the State Permit or one of the Federal Permits does not automatically cause revocation of the other Permits.

24.10 Assignment or Transfer

This Agreement will be binding on and inure to the benefit of the Parties and their respective successors and assigns. Assignment or other transfer of the Permits or any rights or authorities granted thereunder will be governed by provisions of the ESA, and the NCCPA pertaining to the assignment or transfer of Permits.

Any obligation of an Authorized Entity may be assigned to any other Authorized Entity consistent with applicable law and upon written execution of an agreement of assignment. Such an assignment shall relieve these respective Parties of their pre-existing obligations under this Agreement only to the extent consistent herewith. Any assignment or other transfer of the Permits must be approved by the applicable Fish and Wildlife Agency.

24.11 Amendments

This Agreement may be amended only by the written agreement of all of the Parties.

24.12 No Partnership

Neither this Agreement nor the BDCP shall make or be deemed to make any Party to this Agreement the agent for or the partner of any other Party.

24.13 No Third Party Beneficiaries

Without limiting the applicability of rights granted to the public pursuant to the ESA, CESA, NCCPA or other applicable law, this Agreement will not create any right or interest in the public, or any member thereof, as a third party beneficiary thereof, nor will it authorize anyone not a Party to this Agreement to maintain a suit for personal injuries or property damages under the provisions of this Agreement. The duties, obligations, and responsibilities of the Parties to this Agreement with respect to third party beneficiaries will remain as imposed under existing State and federal law.

24.14 Elected Officials not to Benefit

No member of, or delegate to, the California State Legislature or the United States Congress will be entitled to any share or part of this Agreement or to any benefit that may arise from it.

24.15 Availability of Funds

All Actions required of the United States or its agencies in implementing this Agreement are subject to appropriations by Congress. Nothing in this Agreement shall be interpreted as or constitute a commitment or requirement that the United States or its agencies obligate or pay funds in violation of the Anti-Deficiency Act, 31 U.S.C. § 1341, or other applicable law. Nothing in this Agreement is intended or shall be construed to commit a Federal official to expend Federal funds not appropriated for that purpose by Congress. To the extent that the expenditure or advance of any money or the performance of any obligation of the United States or its agencies, or any Secretary under this Agreement is to be funded by appropriation of funds by Congress, the expenditure, advance, or performance shall be contingent upon the appropriation of funds by Congress that are available for this purpose and the apportionment of such funds by the Office of Management and Budget. No breach of this Agreement shall result and no liability shall accrue to the United States or its agencies or any Secretary in the event such funds are not appropriated or apportioned. Nothing in this Agreement is intended or shall be construed to require the obligation, appropriation, reprogramming, or expenditure of any funds by the United States or its agencies, except as otherwise permitted by applicable law.

Implementation of this Agreement and the BDCP by DWR and CDFW is subject to the availability of appropriated funds. Nothing in this Agreement will be construed by the Parties to require the obligation, appropriation, or expenditure of any money from the Treasury of the State of California. The Parties acknowledge and agree that DWR and CDFW will not be required under this Agreement to expend any State-appropriated funds unless and until an authorized official of that agency affirmatively acts to commit such expenditure as evidenced in writing.

24.16 Duplicate Originals

This Agreement may be executed in any number of duplicate originals. A complete original of this Agreement will be maintained in the official records of each of the Parties hereto.

24.17 Calendar Days

Throughout this Agreement and the BDCP, the use of the term "day" or "days" means calendar days, unless otherwise specified.

24.18 Response Times

Except as otherwise set forth herein or as statutorily required by CEQA, NEPA, CESA, the ESA, NCCPA or any other laws or regulations, the Parties will use reasonable efforts to respond to written requests from any Party within a forty-five (45) day time period.

24.19 Attorney's Fees

If any action at law or equity, including any action for declaratory relief, is brought to enforce or interpret the provisions of this Agreement, each Party to the litigation will bear its own attorneys' fees and costs. Notwithstanding the foregoing, attorneys' fees and costs that may be recoverable against the United States may be sought as provided by applicable federal law.

24.20 Governing Law

This Agreement will be governed by and construed in accordance with the laws of the United States and the State of California, as applicable.

24.21 Headings

Headings are used in this Agreement for convenience only and do not affect or define the Agreement's terms and conditions.

24.22 Defense

Upon request by any Party, other Parties hereto shall reasonably cooperate in defending lawsuits regarding the BDCP, this Agreement, or the Permits. Such cooperation may include, but is not limited to, entering into a joint defense agreement and cooperation among the DWR, SWP/CVP Contractors, CDFW, USFWS and NMFS in the preparation of an administrative record.

24.23 Due Authorization

Each Party represents and warrants that (1) the execution and delivery of this Agreement has been duly authorized and approved by all requisite action, (2) no other authorization or approval, whether of governmental bodies or otherwise, will be necessary in order to enable it to enter into and comply with the terms of this Agreement, and (3) the person executing this Agreement on behalf of each Party has the authority to bind that Party.

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COMMENTS OF SAVE THE CALIFORNIA DELTA ALLIANCE ON THE BAY DELTA CONSERVATION PLAN / CALIFORNIA WATERFIX 2015 RECIRCULATED DRAFT ENVIRONMENTAL IMPACT REPORT / ENVIRONMENTAL IMPACT STATEMENT

October 30, 2015

Lead Agencies
BDCP/California WaterFix
BDCPComments@icfi.com

The following comments are submitted on behalf of Save the California Delta Alliance. We wish to thank the Lead Agencies for this opportunity to submit comments and for considering our views.

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I. These Comments Focus Directly On The RDEIR/S; References To The 2013 Draft EIR/S Are Required By The Way The Lead Agencies Have Structured These Documents And Substantive Responses To Comments Herein Reliant On The 2013 Draft EIR/S Are Required By NEPA and CEQA.

These comments focus directly on the analysis in the RDEIR/S and must necessarily address the 2013 Draft EIR/S because the 2015 RDEIR/Sß fails to include a reasonable range of alternatives that stems directly from and relies upon the 2013 Draft EIR/S. In order to understand and respond to new alternatives 4A, 2D, and 5A, and assess whether these new alternatives fill out a "reasonable range of alternatives," it is necessary to understand the screening and development of alternatives presented in the 2013 Draft EIR/S. Where that process was flawed or incomprehensible, references to it and requests for corrections are appropriate at this point. Portions of these comments that describe and analyze portions of the 2013 Draft EIR/S are necessary, and must be allowed, in order to make meaningful comments on the RDEIR/S. Further, the public must be able to *understand* the 2013 Draft EIR/S in order to understand the RDEIR/S. Comments directed to failure of the 2013 Draft EIR/S as an informational document are indispensible to a lawful CEQA/NEPA process.

Many commenters called for changes in the 2013 Draft EIR/S and for repairs to its informational presentation. The 2015 DEIR should have responded to these calls, but largely did not. These failures of the 2015 DEIR can only be meaningfully addressed by references to the 2013 Draft EIR/S.

Further, the 2015 RDEIR/S re-issues, revises, and incorporates the 2013 Draft EIR/S in 2015 Appendix A. The 2013 Draft EIR/S is an integral, current, component of the 2015 RDEIR/S. References to the original pagination/section numbering in the 2013 Draft EIR/S, rather than the same information as it is re-presented in Appendix A, are necessary to a clear and comprehensible presentation and to allow a meaningful response to these comments. This is particularly so in light of the condition of informational chaos present in BDCP/Fix environmental review documents.

Failure to respond to any of the criticisms presented in these comments on grounds that the comment period on the 2013 Draft EIR/S has closed would violate the duty of the Lead Agencies to respond to comments as required by NEPA and CEQA.

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II. The 2013 Draft EIR/S And 2015 RDEIR/S Fail As Informational Documents.

A. The EIR/S-RDEIR/S Fails To Meet Minimal Requirements For Fostering Informed Agency Decision-Making And Informed Public Participation.

"[T]he touchstone for our inquiry is whether an EIS's selection and discussion of alternatives fosters informed decision-making and informed public participation. *State of Cal. v. Block*, 690 F.2d 753, 766-67 (9th Cir. 1982). The BDCP/Fix EIR/S does not. "The Current Draft lacks key information, analyses, summaries, and comparisons. The missing content is needed for evaluation of the science that underpins the proposed project. Accordingly, the Current Draft fails to adequately inform weighty decisions about public policy." 2015 ISB DEIR Review 4 (Attachment 21).

"Judicial review of the range of alternatives considered by an agency is governed by a 'rule of reason' that requires an agency to set forth only those alternatives necessary to permit a 'reasoned choice.'" *State of Cal. v. Block*, 690 F.2d at 767. "These reasonable expectations go largely unmet in the Bay Delta Conservation Plan/California WaterFix Partially Recirculated Draft Environmental Impact Report/Supplemental Draft Environmental Impact Statement Draft. We do not attempt to determine whether this report fulfills the letter of the law. But we find the Current Draft sufficiently incomplete and opaque to deter its evaluation and use by decision-makers, resource managers, scientists, and the broader public." 2015 ISB DEIR Review 1.

It is perhaps unnecessary to add to the ISB's comments to make the point that the EIR/S-RDEIR/S fails as an informational document within the meaning of 42 U.S.C. § 4332, the large body of case law requiring that environmental impact statements be informative and comprehensible, and applicable Council on Environmental Quality implementing regulations. If a panel of eminent scientists, charged by the California Legislature with being the preeminent science advisors to Delta decision-makers, and who have followed and participated in the BDCP/Fix process from the beginning, find the documents "incomplete and opaque," it would seem a tautology to argue that less specialized participants, such as lawyers representing stakeholders, let alone members of the public, could not be reasonably informed by the documents.

The comments of the Delta ISB reflect the frustration of almost all stakeholders with the obdurate obduracy[1] of those responsible for preparing BDCP/Fix documents in refusing to heed repeated and longstanding calls for documents that meet the basic requirements of informed decision-making:

> For over three years, the Delta ISB has been specifically requesting summaries and comparisons: first in June 2012, then in June 2013, and again in a review of the Previous Draft in May 2014. Appallingly, such summaries and comparisons remain absent in the current draft.

2015 ISB DEIR Review 9 (footnotes omitted).

For example, a reviewer attempting to understand alternative 9A would be confronted with the following tortured journey through project documents.

[1] For a discussion of obduracy in a legal context, *see Fink v. Gomez*, 293 F.3d 989, 992 (9th Cir. 2001).

Alternative 9A (discussed substantively in section III.E.) was apparently intended to comply with the requirement of the California Legislature that the Lead Agencies consider a scientific report issued by the California State Water Resources Control Board explicitly for the use of the Lead Agencies in developing the BDCP. "For the purposes of informing planning decisions for the Delta Plan and the Bay Development and Conservation Plan, the board shall, pursuant to its public trust obligations, develop new flow criteria for the Delta ecosystem necessary to protect public trust resources." Cal. Water Code § 85086(c)(1) ("Flow Criteria Report").

The SWRCB issued the Flow Criteria Report on August 3, 2010. It calls, in brief, for restoration of Delta flows to 75% of unimpaired flow. The report stresses that it takes account only of "the flows that would be needed in the Delta ecosystem if fishery protection was the sole purpose for which its waters were put to beneficial use." Flow Criteria Report cover page. It does not (and was not commissioned to) perform the extensive detailed analysis needed to balance fishery protection with other beneficial uses, including water supply, nor does it examine how to implement a restoration of 75% of unimpaired flow. It does conclude that restoration of 75% of unimpaired flow is necessary to protect public trust resources in the Delta at certain times of the year and that other standards for Delta outflow also are necessary to protect public trust resources. Flow Criteria Report 98.

It was incumbent upon the Lead Agencies to consider alternatives that examined the flow criteria goal in the context of meeting water supply and other beneficial use needs. However, the EIR/S-RDEIR/S's treatment of Alternative 9A is frustratingly obscure, opaque, and contradictory and it is nowhere apparent that appropriate consideration to the relevant factors was given.

First, Alternative 9A is treated within 2013 Draft EIR/S Chapter 3 (in the body of the EIR/S) and subsequently in Appendix 3A. Chapter 3 is titled "Description of Alternatives" and is 212 pages long. Chapter 3 repeatedly refers the reader to Appendix 3A for an explanation of the screening process and those alternatives that were summarily dismissed without detailed examination. The reader is advised to refer to Appendix 3A "for description of alternatives that were eliminated." 2013 Draft EIR/S 3-7. Appendix 3A contains ninety-four pages of text and an additional sixty-three pages of tables. Although pdf bookmarks appear *after* downloading Appendix 3A, there is no table of contents for Appendix 3A, tables or text. No bookmarks at all appear for the sixty-three pages of tables. The main table of contents for the entire EIR/S lists Appendix 3A only as "Identification of Water Conveyance Alternatives, Conservation Measure CM1." 2013 Draft EIR/S lxxiv. Many of the crucial tables in Appendix 3A are printed in text that appears to be five or six-point. *See, e.g.,* 3A-146 (left hand column) (Attachment 1). Appendix 3A also has seven attachments, consuming 104.47 megabytes of disk space. The table of contents does not list the titles of the attachments and there are no bookmarks for the separate attachments.[2]

It is within this informational setting, then, that the interested reader must pursue Alternative 9A—the only alternatives response to the express call of the California

[2] It occurred to the present reviewer that the omission of tables of contents for the critical documents could not have passed unnoticed. However, no erratum providing the tables of contents was found. There is a link at the bottom of the 2013 Public Review Draft BDCP EIR/EIS document page entitled "Errata to the Draft EIR/EIS." None of the omitted tables of contents were found at this link.

Legislature and subject of a scientific report issued at the direction of the California Legislature expressly for the use of the Lead Agencies in formulating the BDCP/Fix project. 2013 Draft EIR/S section 3.2.2 states that screening alternatives (including 9A) "were evaluated to narrow them to a more manageable field by eliminating similar or duplicative features (i.e., based on conveyance facilities or operations), or because the alternative would fail to meet the purpose and need for the BDCP or would likely violate federal and state statutes or regulations."

Accordingly, "the following conveyance alternatives were dismissed from further evaluation as detailed in Appendix 3A." 2013 Draft EIR/S 3-12. Six screening alternatives, including screening Alternative 9A, are then listed as being dismissed. *Id*. No reference to page numbers in Appendix 3A is provided as to where the reader will find details on what these alternatives contained or why they were dismissed. No explanation or notation as to which of the proffered reasons (duplicative features, fail to meet purpose and need, or violate statutes or regulations) applies to which alternative.

Turning to Appendix 3A, the alternatives are inconsistently and incrementally described. *Compare* 3A-11 and 3A-43–50, and renumbered, *see* 3A-53, and renumbered again, *see* 3A-72–73, and renumbered again, *see* 3A-79 ("the conveyance alternatives have been renumbered to be consistent with information presented in the BDCP process"). There is no concordance table or straightforward, comprehensible explanation or chart showing the progress of alternatives identification and transformation.

Alternative 9A first appears in Appendix 3A with a one-sentence description at 3A-72. Alternative 9A next appears at table 3A-12 with a one-sentence description in what appears to be five- or six-point font. 2013 Draft EIR/S 3A-145, and again at table 3A-13 with the same one-sentence description, and again at table 3A-14 with an additional one-sentence description indicating that it would likely require "reducing deliveries to upstream water rights holders." 2013 Draft EIR/S 3A-148.

Alternative 9A is apparently eliminated from consideration in the EIR/S by table 3A-17, which answers the question as to whether the range of alternatives would result in the impairment of "existing senior water rights" as follows: "No for the range of conveyance alternatives that have been consistent with the three levels of screening criteria" although some alternatives may require a "change in legal ownership due to sale of property." 2013 Draft EIR/S 3A-150. Alternative 9A was included in the chart applying third-level screening criteria and is a second-screening alternative. The table text continues, in what appears to be eight-point font, "However, the answer would be likely for Second Screening Dual Conveyance Alternative 8A, which includes operations alternatives based on Scenario 7a, and Second Screening Dual Conveyance Alternative 9A, which includes the State Water Resources Control Board 2010 flow recommendations for Delta Ecosystem." However, Alternative 9A was carried forward to Table 3A-21, the last of the Appendix 3A tables, and the closest thing (along with preceding Table 3A-20) to a coherent summary of alternatives. This table reports that Alternative 9A was eliminated because it "probably would violate federal or state statutes or regulations." 2013 App. A 3A-157. This must be a reference to Table 3A-14 Column 6, which indicates that Alternative 9A would likely violate statutes or regulations because "Delta outflow criteria could not be accomplished even with reducing deliveries to upstream water rights holders." 2013 App. A 3A-148.

Section 3A.9.3 is entitled, "State Water Resources Control Board Enhanced Spring Delta Outflow Alternative." 2013 Draft EIR/S 3A-62. This alternative is discussed in the context of the SWRCB Flow Criteria Report. The "alternative includes a requirement of 55% of unimpaired flow, as estimated for the Sacramento River at Freeport, to become Delta outflow." 2013 Draft EIR/S 3A-64. Section 3A.9.3 does not disclose under which numbered alternative, if any, this alternative is analyzed as in the EIR/S. A separate perusal of Appendix 3A reveals, as best as can be determined, that it wound up as Alternative 8. Section 3A.9.3 appears to be the closest approximation, untitled and unreferenced as such, that analyzes or explains why the 2010 Flow Criteria Report recommendation of 75% of unimpaired flow was not carried forward as an alternative in the EIR/S or what became of it.

This garble of information for Alternative 9A is repeated for the 15 conveyance alternatives identified in scoping (*see* Appendix 3A at 3A-11), the 21 alternatives listed at section 3.2.1.5 (*see* 2013 Draft EIR/S 3-10), and various other "proposals" that were never given a number and are treated at section 3A.11 (which repeatedly refers the reader back to numerous components of other alternatives treated elsewhere) of Appendix 3A. *See* 2013 Draft EIR/S Appendix 3A 3A-80–94.

To follow the disposition of Alternative 9A, the doggedly determined reader is left to print out a dozen sub-sections of the EIR/S, lay them on a table, shuttle back and forth between them, and create his or her own concordance table and table of contents, and ultimately construct his or her own comparison.

It is unreasonable to expect members of the public and even specialized commenters–let alone decision-makers–to follow that same procedure for all of the alternatives (importantly including those eliminated in scoping and those referred to as "proposals"), much less construct his or her own comparison of all these alternatives:

> According to guidance for project proponents, "Environmental impact statements shall be written in plain language and may use appropriate graphics so that decision-makers and the public can readily understand them" (Code of Federal Regulations, 40 CFR 1502.8). Far-reaching decisions should not hinge on environmental documents that few can grasp.
>
> This guidance applies all the more to an EIR/S of the scope, complexity, and importance of the Current Draft. It demands excellent comparative descriptions of alternatives that are supported by readable tables and high-quality graphics, enumeration of major points, well-organized appendices, and integration of main figures with text. For policy deliberations, the presentation of alternatives should include explicit comparisons of water supply deliveries and reliabilities as well as economic performance. For decision-makers, scientists, and the public, summaries of impacts should state underlying assumptions clearly and highlight major uncertainties. The current draft is inadequate in these regards.

2015 ISB DEIR Review 9.

Promises that these deficiencies will be corrected in the final project documents do not fulfill the purposes of NEPA and CEQA, which are to provide decision-makers with comprehensible information upon which to base their decisions early in the process, when changes of course are practicable. Depriving the public of comprehensible information until after final decisions have been made further frustrates informed public participation and constitutes actionable informational injury as well as depriving decision-makers of informed comments to guide their deliberations.

B. The 2015 RDEIR/S Compounds The Informational Injury Inflicted By BDCP/Fix Environmental Review Documents Because It Adds Further Confusion And Is Misleading.

The 2015 RDEIR contains several features that may have been intended to address the informational chaos created by the 2015 Draft EIRS. For example, the 2015 RDEIR/S provides an Appendix A, which is a redline version of the 2013 Draft EIR/S. This could be a useful feature. However, the Lead Agencies have chosen to renumber all the sections, without providing a concordance table or a table of contents.[3] Some new text is indicated in redline insertion text. Some new text is not so indicated. The pagination has been radically altered. For example, 2013 page 8-420 has become 2015 Appendix A page 8-217. These pages describe significant unmitigated impacts on water quality. They are crucial. The section under which this critical text appears has yet again been renumbered, from 8.4.3.9 to 8.3.3.9. *Compare* 2015 RDEIR/S Appendix A 8-204 *with* 2013 Draft EIR/S 8-407. The numbering change does not appear in strikeout or underline. Absent a concordance table and/or table of contents/concordance of table of headings (new and original), Appendix A is a source of frustration that will drive away informed comments. The present reviewer can imagine no rational basis for the failure to use well-established techniques, such as keeping all original heading numbering the same and inserting new headings as .0001, .0002, etc.

As it stands, the most expedient way to find out what changes were made to a specific passage from the 2013 Draft EIR/S is to select unique phrases from the 2013 text of interest and run a word search in Acrobat on the 2015 Appendix A in hopes of landing at the correct text.

A line has to be drawn somewhere as to how confusing, poorly organized, and poorly presented NEPA/CEQA documents may be. Here, the line has been crossed and the only remedy is to re-draft the 2015 RDEIR/S and reopen the comment period, if for no other reason than to address the basic requirement of informing the public as to what is being proposed and evaluated, and to allow for informed public comment at stages early enough to allow their meaningful use by decision-makers.

More troubling yet is the misleading presentation of several critical portions of the 2015 RDEIR/S. For example, table ES-9 purports to summarize the impacts of the three new alternatives (2D, 4A, and 5A) (Attachment 2). However, it lacks a key feature: a further column that would direct the reader to the text of the DEIR that supports the table's conclusory presentations. This leads to a misstatement of impacts.

Two of the significant unmitigated adverse impacts/effects of preferred Alternative 4A disclosed by the 2013 Draft EIR/S were GW-8 and GW-9, which are statewide impacts to groundwater. Table ES-9 lists GW-8 and GW-9 as having no impact for new alternatives 2D, 4A, and 5A. 2015 RDEIR ES-43. However, a tiny footnote cue, appearing only on the

[3] Like 2013 Appendix 3A, there are only pdf bookmarks available after download.

column "Impact Conclusion Before Mitigation," directs the reader to footnotes stating that the preferred alternative, Alternative 4A, "could have" significant/adverse unmitigated impacts on groundwater. The right-hand column, "Impact After Mitigation," lists Alternative 4A as LTS and B (less than significant or beneficial). This is false. The actual finding purporting to be summarized is that the "overall impact for Alternative 4A [on groundwater supplies and recharge is] considered significant and unavoidable." REDIER/S 4.3.3-8. Most readers of this table will skim the right-hand columns, which list as "S" or "SU" or "A" those impacts that are significant and unmitigated. On this method, Alternative 4A appears benign, which it is not. An executive summary table constructed with the aim of *alerting* readers to significant impacts that are worthy of further perusal in the body of the document would not have presented information in this manner.

In addition to noncompliance with CEQA and NEPA, and relevant federal government contracting requirements, it may further be argued that the deterrent effect of these documents is so great as to deprive the public of its right to petition the government for a redress of grievances within the meaning of the First Amendment to The United States Constitution. Physical exclusion of dissenting citizens from a hearing room would have no more pernicious effect than the organization of these documents, especially if deceptive intent is found.

III. The 2015 RDEIR/S Fails To Consider A Reasonable Range Of Alternatives.

The current range of Alternatives (including new Alternatives 2D and 5A) and the preferred project (Alternative 4A) do not represent a reasonable range of alternatives as required by CEQA and NEPA. For the following reasons, a second revised RDEIR/S should be issued for public comment that includes some or all of the alternatives discussed below.

A. The Extent Of The Lead Agencies' Duty To Rigorously Explore And Objectively Evaluate All Reasonable Alternatives Is At Its Zenith In This Matter.

An agency must "study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative use of available resources." 42 U.S.C.A. § 4332(2)(E). "Judicial review of the range of alternatives considered by an agency is governed by a 'rule of reason' that requires an agency to set forth only those alternatives necessary to permit a 'reasoned choice.'" *California v. Block*, 690 F.2d 753, 767 (9th Cir. 1982). The "touchstone for our inquiry is whether an EIS's selection and discussion of alternatives fosters informed decision-making and informed public participation." *Id*.

As acknowledged in the RDEIR/S, federal agencies are required to take a "hard look" at the environmental consequences of their actions, including a hard look at potential alternatives to recommended courses of action that might lessen environmental impacts. *See* RDEIR/S 4.1-3. "The purpose of NEPA is to require disclosure of relevant environmental considerations that were given a 'hard look' by the agency, and thereby permit informed public comment on proposed actions and any choices or alternatives that might be pursued with less environmental harm." *Te-Moak Tribe of Western Shoshone of*

Nevada v. United States Dep't of the Interior, 608 F.3d 592, 601 (9th Cir. 2010) (citation omitted). "The existence of a viable but unexamined alternative renders an environmental impact statement inadequate." *Id.* (citation omitted).

It would be hard to overstate the conflicts surrounding alternative competing uses of Delta water resources, including but not limited to the conflicts between environmental needs and water supply needs; and the conflicts between in-basin consumptive users, upstream diverters, and export consumptive users. It would also be hard to overstate the cost of a wrong decision. The ecosystem of the largest and most important estuary on the west coast of North and South America is on the brink of collapse. The wrong decision could push numerous species to extinction and take a horrific toll on communities and the economies that rely on Delta water. Indeed, near final drafts of the BDCP, as operated in and in conjunction with expected climate-changed conditions, and vetted by the Lead Action Agencies, would have driven important fish species, including winter-run and spring-run Chinook salmon, to extinction. *See NMFS Progress Assessment and Remaining Issues Regarding the Administrative Draft BDCP Document* 1 ("Red Flag Comments") (Attachment 22).

The responsibility of the Lead Agencies in this matter to "describe appropriate alternatives," 42 U.S.C. § 4332(2)(E), that are "necessary to permit a 'reasoned choice,'" *California v. Block*, 690 F.2d at 767, after a "hard look" at environmental consequences in the context of lessening them by considering alternative courses of action, *Te-Moak*, 608 F.3d at 601, is commensurate with the gravity and far-reaching consequences of the ultimate decision in this matter. In short, the Lead Agencies' public duty to "rigorously explore and objectively evaluate all reasonable alternatives," 40 C.F.R. § 1502.14(a), is here at its zenith. The federal Lead Agencies would perhaps not dispute this characterization of their duty. What we ask, upon review of these and all other comments on the RDEIR, is for the Federal Lead Agencies to earnestly re-examine whether they have lived up to it.

B. The BDCP/Fix Statements Of Purpose And Need May Not Be Drawn Or Interpreted In Terms So Narrow As To Unreasonably Limit The Range Of Alternatives Considered.

On February 13, 2009, the Lead Agencies issued a Notice of Intent to Prepare an Environmental Impact Statement/Environmental Impact Report and Notice of Public Scoping Meetings pursuant to NEPA, 74 FR 7257 ("2009 NOI"), and a Revised Notice of Preparation OF Environmental Impact Report and Environmental Impact Statement for the Bay Delta Conservation Plan, State Clearinghouse Number 2008032062, pursuant to CEQA ("2009 NOP"). These statements remained in effect until they were revised on July 10, 2015, as part of the RDEIR/S.

These documents contain the statement of purpose and need and the statements of objectives and fundamental underlying purpose pursuant to NEPA and CEQA respectively. Because the framing and interpretation of these statements are closely related to the duty to discuss alternatives, they are being increasingly used by lead agencies to limit the range of alternatives they wish to consider. As explained by leading practice guides on NEPA and CEQA:

> [An EIS] must briefly specify the underlying purpose and need to which the agency is responding in proposing the alternatives including the proposed action … . The courts have recognized these requirements are closely related to the duty to discuss alternatives, because the purpose of an action determines the universe of alternatives an agency must consider.

Daniel R. Mandelker, *NEPA Law and Litigation* § 9:23 (Thomson Reuters 2015) (citations and quotation marks omitted) ("*NEPA Law and Litigation*").

> Lead agencies have considerable discretion to select the project objectives they wish to achieve. Although a lead agency may not give a project's purpose an artificially narrow definition, a lead agency may structure its EIR alternatives analysis around a reasonable definition of underlying purpose and need not study alternatives that cannot achieve that basic goal.

Stephen I. Kostka and Michael H. Zischke, *Practice Under the California Environmental Quality Act* (CEB 2d ed. 2015) ("*Practice Under CEQA*").

However, courts are increasingly recognizing that lead agencies may abuse the statement of purpose and need to evade the requirement to earnestly evaluate a reasonable range of alternatives. *See, e.g., National Parks & Conservation Ass'n v. Bureau of Land Mgmt.*, 606 F.3d 1058, 1072 (9th Cir. 2009) (summarizing 9th Circuit precedent to "forbid the [lead agency] to define its objectives in unreasonably narrow terms") (striking down lead agency's EIS because "[a]s a result of this unreasonably narrow purpose and need statement, the [lead agency] necessarily considered an unreasonably narrow range of alternatives"); *see also id*. at 1071 (stating that the court will "determine whether the [lead agency's] purpose and need statement properly states the [lead agency's] purpose and need … in a manner broad enough to allow consideration of a reasonable range of alternatives").

Courts also scrutinize unreasonably narrow interpretations of purpose and need statements by lead agencies where the statement of purpose and need, fairly read, would allow for consideration of alternatives that the lead agency rejected as outside the project's purpose and need statement. *See, e.g., Center for Biological Diversity v. National Highway Traffic Safety Admin.*, 538 F.3d 1172, 1219 (9th Cir. 2008) (holding that "[w]e also disagree with [the lead agency] that Petitioners' suggested alternatives would not be reasonably related to the project's purpose").

C. The Project's Range Of Alternatives Described In The 2015 DEIR Is Unreasonably Limited By Excluding All Storage, Groundwater, Integrated Water Management, And Conservation Elements From Consideration And Failing To Give Meaningful Consideration To Conveyance Options.

1. At The Very Outset Of The Process, The Lead Agencies Unreasonably Eliminated Any Portfolio Approach By Drafting And/Or Interpreting The 2009 Statement Of Purpose And Need In Unreasonably Narrow Terms And Drafted The Revised 2015 Statement In Unreasonably Narrow Terms.

Virtually all stakeholders agree a "portfolio" approach is required if we are to make meaningful progress in solving California's water problems. A portfolio approach simply combines elements of conveyance with one or more elements of storage, groundwater management/recharge, and conservation. However, the Lead Agencies unreasonably eliminated any possibility of a portfolio approach at the outset of the process.

"Scoping" is the process undertaken at the outset of environmental review to determine the scope of issues that the EIS will include. As part of the scoping process the lead agency shall "[d]etermine the scope and the significant issues to be analyzed in depth in the environmental impact statement." 40 C.F.R. § 1501.7(a)(2).

The 2009 NOI, which contained the statement of purpose and need, also announced the commencement of 10 public scoping meetings. However, through their drafting/interpretation of the statement of purpose and need announced in the 2009 NOI, the Lead Agencies had already effectively eliminated from meaningful consideration any water infrastructure other than conveyance within the statutory Delta:

> The 2009 NOP and NOI stated that the new points of diversion could be located along the Sacramento River between South Sacramento and Walnut Grove. The new conveyance facility could extend from the new points of diversion to the existing SWP and CVP pumping facilities in the South Delta and be located either to the west or east of the Sacramento River.

2013 Draft EIR/S, App. 3A 3A-11.

The Lead Agencies' interpretation of the 2009 NOI/NOP had also absolutely eliminated from consideration any conservation element; had eliminated from consideration any groundwater component; and had eliminated from consideration any storage component. The 2015 revised statement of purpose in need is narrowed and also excludes storage. This is a failure to respond to changed circumstances because the need for storage has become all the more acute as recognition of the severe diminishment of the snowpack as a storage element has become much better understood and more pronounced in the last six years. It was out of bounds from this point forward for the Lead Agencies to meaningfully consider any portfolio approach or any surface storage, groundwater recharge and storage, or demand reduction/management measures.

The 2015 Revision to the statement of purpose and need only further unreasonably narrows the purpose and need.

The now six-year-old environmental review process, while producing tens of thousands of pages of reports, convening dozens of public meetings, drawing thousands of comment letters, and proclaiming itself one of the most thorough ever undertaken, had eliminated the most promising alternatives at the outset. The 2015 RDEIR/S revision to the statement of purpose and need should have corrected course by including a reasonable range of alternatives, but it did not. All of the hundreds of thousands of hours of study and hundreds of millions of dollars in consultant's fees were focused on assessing a badly defined project with a self-imposed constraint that forbids or refuses consideration of better alternatives.

As explained to the public:

> While water storage is a critically important tool for managing California's water resources, developing new water supplies and including new storage is not part of the BDCP purpose and need.

2013-4 Your Questions Answered, *available at http://baydeltaconservationplan.com/Library/BDCPLibrary/YourQuestionsAnswered.aspx* (last visited October 23, 2015) (Attachment 3).

"New water supplies" or "new water" as used in the BDCP/Fix documents, and in California water discussions generally, includes storage and conservation measures. Increasing storage capacity makes "new water" because it allows the capture and storage of water supplies that would not otherwise be available; it increases the total amount of water available for management. Likewise, conservation measures are considered to provide "new water" because "using water more efficiently reduces demand, which has the same effect as adding water to the system." Delta Plan 91, n.1.

The Lead Agencies, therefore, dismissed the basic reaction to initial scoping by concerned stakeholders whose comments "described methods to reduce reliance upon Delta water supplies, including water conservation, recycling, and use of other water supplies such as conjunctive use programs to ensure adequate groundwater recharge operations." 2013 Draft EIR/S App A 3A-11.

Where this process has ended up, stand-alone (single-focus) new conveyance infrastructure, is one of the few choices that were available to the Lead Agencies that *does not* increase water supplies:

> The benefits of new Delta conveyance infrastructure should be maximized by integrating with new and expanded storage projects, implementing projects that increase water-use efficiency and conservation, improving groundwater management, and restoring the structure and function of some key Delta ecosystems. New Delta conveyance infrastructure by itself does not create any new supplies of water.

Delta Stewardship Council, *18 Principles for Water Conveyance in the Delta, Storage Systems, and for the Operation of Both to Achieve the Coequal Goals* ¶ 4, *available at*

http://www.deltacouncil.ca.gov/docs/delta-stewardship-council-october-22-23-2015-meeting-agenda-item-10-attachment-1-draft) (Attachment 20).

The Lead Agencies' narrow drafting/and or narrow interpretation of the purpose and need of the project as excluding "developing new water supplies" also excludes groundwater storage from meaningful consideration. Groundwater storage is considered a source of "new water" and has the potential to provide up to two million acre-feet of new water annually. *See, e.g.* Delta Plan 92 (Attachment 4).[4] But because it is considered a source of "new water" it has been excluded by the Lead Agencies, through use of the purpose and need statement, from meaningful consideration.

The 2009 NOI stated that "improvements to the conveyance system are needed" and that the project would include "three major elements," one of which was "potential capital improvements to the water conveyance system." 74 FR 7259. However, the description of potential alternatives in the 2009 NOI stated that:

> Three general alternatives are being considered as they relate to the potential changes in the water conveyance system and CVP/SWP operations. These include (1) A through-Delta alternative; (2) a dual conveyance alternative; and (3) an isolated facility alternative.

Each of these alternatives was limited to conveying water from a point on the Sacramento River between South Sacramento and Walnut Grove to the existing CVP and SWP pumping plants near Tracy, about forty miles away. 2013 Draft EIR/S App. 3A 3A-11.[5]

The elimination of serious consideration of *any* portfolio alternatives was unreasonable on its face. *See, e.g.*, *National Highway Traffic Safety Administration*, 538 F.3d 1172, 1219 (9th Cir. 2008) (striking down impact statement and rejecting lead agency's argument that "Petitioners' suggested alternatives would not be reasonably related to the project's purpose").

Groundwater recharge, surface storage, and conservation are all reasonably related to the project's purpose. Project documents repeatedly state that the underlying goal of the project is to improve deliveries of water to consumptive users while at the same time improving ecological conditions in the Delta:

"As described in Chapter 1, *Introduction*, the BDCP is intended to provide for the ecological needs of a number of at-risk species adversely affected by a range of human activities while also ensuring adequate and reliable water supplies from the Sacramento-San Joaquin River Delta (Delta) and its stream tributaries, for people, communities, agriculture, and industry." Draft EIR/S App. 3G-2 (2013). "As stated in Section 1, *Introduction*, the RDEIR/SDEIS considers additional sub-alternatives that meet the goals of restoring the ecological functions of the Delta and improving water supply reliability."

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[4] The 2013 Delta Plan has long been available to the lead agencies and was made a part of the administrative record in its entirety as a part of comments in July 2014. Several excerpts are attached here for the convenience of the reader.

[5] Two conveyance components outside the statutory Delta, one conveying water from a point on the Sacramento River near the confluence of the Feather River, and the other from a point near Fremont Weir, were summarily eliminated without evaluation as project alternatives in the EIR/S.

RDEIR/S 4.1-1 (2015). "The current and projected future inability of the SWP and CVP to deliver water to meet the demands of certain south of Delta CVP and SWP water contractors is a very real concern. More specifically, there is an overall declining ability to meet defined water supply delivery volumes and water quality criteria to support water users' needs for human consumption, manufacturing uses, recreation, and crop irrigation." 2013 Draft EIR/S 2-6. *See also* our July 29, 2014, comments for further explication of the project purpose and need.

Federal regulators, who are not project proponents, also understand that the project has a broad fundamental purpose. "EPA fully supports the stated purpose of the BDCP effort: to produce a broad, long-term planning strategy that would meet the dual goals of water reliability and species recovery in this valuable ecosystem ... ." Letter from Jared Blumenfeld, Regional Administrator, Region 9 United States Environmental Protection Agency to Will Stelle, Regional Administrator, West Coast Region National Marine Fisheries Service 1, August 26, 2014 ("August 26, 2014, EPA Comments") (Attachment 23). Federal regulators understand that portfolio approach alternatives are well within the BDCP/Fix project's purpose and need. "Other reasonable alternatives could be developed by incorporating a suite of measures, including Integrated Water Management, water conservation, levee maintenance, and decreased reliance on the Delta. Such alternatives would be consistent with the purpose and need for the project, as well as with the California Bay Delta Memorandum of Understanding among federal agencies and the Delta Reform Act of 2009." *Id.* at 3.

Not only is a portfolio approach consistent with the Statement of Purpose and Need, the Lead Agencies' own science advisors deem it indispensible. In 2014, the Action Lead Agencies commissioned four eminent Delta scientists to author a report addressing the challenges facing the Sacramento-San Joaquin Delta in the context of solving the vexing problems of water supply and ecological degradation. *See* Louma, et. al, *Challenges Facing the Sacramento-San Joaquin Delta* (Delta Science Program 2015) ("*Delta Challenges"*) (Attachment Five). *Delta Challenges* concludes that Delta problems are too complex to be addressed by single-focus solutions, such as lone conveyance projects. "Single-focus problem solving can create unanticipated outcomes." *Delta Challenges* 9. Instead:

> Simultaneous attention to a portfolio that includes actions like addressing overuse and mis-use of water, and improving ground water management and storage, *should accompany any necessary water infrastructure adjustments*.

Delta Challenges 4 (emphasis added).

The rejection of portfolio elements on purpose-and-need rationale was unreasonable.

2. A Portfolio Approach With Additional Conveyance Options Is Reasonable, Feasible, Proven, And Necessary And Should Have Been Included In The 2015 RDEIR/S.

The self-imposed limitation of considering conveyance options located only within the statutory Delta excludes many types of viable conveyance improvements. For example, the SWP and CVP canal system, along with interconnected regional canals, stretches from the Delta south to the Mexican border, west to the coastline at Santa Barbara, and east to Arizona. Many critically over-drafted groundwater basins lie adjacent to this extensive canal network, which forms the largest and most complex piece of water supply infrastructure in the United States (if not the world). Attachment 6 (Delta Plan 70) is a map of the canal network. Attachment 7 (Delta Plan 98) is a map showing the location of critically over-drafted ground water basins.

Smaller regional conveyance improvements, in the form of branch lines connecting to groundwater recharge facilities, or improvements to existing branch lines, along much of the route already traversed by existing canals could create new water by recharging badly over-drafted aquifers.

As discussed in our comments of July 29, 2014 ("Delta Alliance July 29, 2014 Comments"), Reclamation has found feasible and approved exactly these types of projects. *See* U.S. Dept. Of the Interior, *Record of Decision: Madera Irrigation District Water Supply Enhancement Project* 1 (approving "Alternative B which includes the banking of MID CVP water outside MID's service area in the proposed WSEP, modification of Reclamation's 24.2 canal and potential federal funding"). *See also Measure J94 Goleta Water District* (local self-imposed ordinance requiring that portions of SWP water supply be devoted to groundwater recharge) (Attachment 8).

There is scientific consensus that recharge of depleted groundwater basins is *feasible* and *necessary* to California's water future. A dozen or so scientific reports emphasizing this fact were attached to our July 29, 2014, comments. In addition to the reports, Lead Agency DWR's California Water Plan, emphasizing the feasibility and necessity of groundwater recharge, was also attached.

The recently released *Delta Challenges* underscores that creating new water to take pressure off the Delta is essential to recovering the Delta ecosystem. "Water scarcity has defined and will continue to define the future of the Delta and all that is linked to it." *Delta Challenges* 28. However:

> Many approaches used in water-scarce environments elsewhere are under-utilized in the Delta. While adjustments to the infrastructure as it ages are essential, opportunities exist to *simultaneously* redefine bold action as we pursue ***proven*** (although not always initially popular) ways to work more effectively with what we have. Examples include the following:
>
> > Groundwater recharge and conjunctive use offer storage potential beyond that available for surface waters.

Delta Challenges 26 (emphasis added) (citations omitted).

We have previously provided detailed comments on the feasibility of portfolio alternatives that include surface storage, either within, north, or south of the Delta. *See* Delta Alliance July 29, 2014, Comments. Our comments included a discussion of Sites Reservoir, also known as North of Delta Offline Storage ("NODOS") as an integral component of a BDCP/Fix portfolio alternative. A "Sensitivity Analysis of Operations with the BDCP" was and is referenced by the NODOS website. http://www.water.ca.gov/storage/northdelta/index.cfm#NODOSDocs, last visited October 27, 2015. The document is still not available to the public. The Lead Agencies should consider it, and if it has not been produced, should produce it and an analysis of integral operation of BDCP/Fix conveyance with NODOS as an alternative to the preferred project. The NODOS Draft EIR was previously provided. A NODOS Investigation Highlights booklet is attached hereto (Attachment 9).[6]

The currently preferred Fix twin tunnels (Alternative 4A) and the identical previously preferred BDCP twin tunnels (Alternative 4) both have the ability to take from the Delta more water more often than the existing infrastructure system. That ability could make sense in the context of restoring the Delta ecosystem and restoring the ability of the "SWP and CVP to deliver up to full contract amounts" while doing less damage to the Delta ecosystem. 2009 NOI, 74 FR 7258. The ability to take more water at times of abundance makes sense when the project also has the ability to convey and store it for use at times of scarcity.

Conveying "surplus" Delta water to groundwater banking facilities so it could be drawn upon when Delta flows are low and exports are most harmful would provide a more reliable water supply and ease the damage of exports to the Delta ecosystem. Alternatives 4 and 4A do not have that ability. The BDCP "does not significantly reduce pressure on the Delta during drier periods." Saracino and Mount, et al., *Panel Review of the Draft Bay Delta Conservation Plan* 30 (September 2013) ("Mount Report") (reviewing Alternative 4 in the 2013 administrative draft BDCP) (attached to our July 29, 2014 comments). "Expanding potential storage, particularly groundwater storage, would have created considerably more flexibility in exports" allowing more water to be harvested in wet years and conserving environmental flows during periods of scarcity. Mount Report 22. Alternative 4A has not meaningfully changed this dynamic. This was the original rationale for new high-capacity conveyance, referred to in BDCP promotional materials as "Big gulp, little sip," that the BDCP/Fix has failed to fulfill.

There is no logic whatsoever in the tunnels' initial intake capacity being set at 9,000 cfs absent integral storage components. There is only the danger, and perhaps probability, that the high-capacity tunnels will be used to meet the project's expressed goal of providing full contract amounts while wreaking further havoc on the Delta ecosystem. This looming disaster is only made more frightening by considering that the tunnels themselves have a capacity to divert 15,000 cfs (a scenario previously given serious consideration by the Lead Agencies) and could be so employed by adding two

[6] We are aware that the Sacramento Valley Water Management Agreement eyes the NODOS project as a source of new water for local interests. However, the project has been languishing at a snail's pace and integration with the DCP/Fix could benefit all interested parties.

additional intakes (that have already been designed) and related diversion components (that have also already been designed).

Increased water use efficiency/conservation, in both urban and agricultural settings, has the potential to produce up to 4.1 million acre-feet of new water annually. Delta Plan 92. In the context of recovering the Delta ecosystem, "Making water conservation a continual, long-term, statewide investment is a necessary part of accepting water scarcity." *Delta Challenges* 26 (citations omitted). Although much of California depends on Delta water for *some* portion of its water supply, the relative contribution of Delta water compared to regional sources is small. *See* Delta Plan 78 (Attachment 19).

Conservation and groundwater recharge are necessary to restore the capacity to deliver up to full contract amounts while at the same time reducing harm to the Delta ecosystem and restoring its health. These elements are reasonably related to the project's purpose and were unreasonably excluded from any meaningful consideration.

The Mount Report, reviewing then-preferred Alternative 4 in September 2013, was commissioned by ex officio BDCP Steering Committee members American Rivers and The Nature Conservancy. In their July 29, 2014, comments on Alternative 4 ("American Rivers 2014 Comments") these organizations summarized the Mount Report's findings:

> While finding that Conservation Measure 1, including the new north Delta diversion, may improve conditions for Delta smelt, the overall conclusion is that the plan will not significantly improve the ecosystem as a whole or assure reliable water supply.
>
> We regretfully conclude that the plan, in its current draft form, will not make a sufficient contribution to the attainment of the co-equal goals as required by applicable laws.

American Rivers 2014 Comments 2. As all are aware, the "coequal goals" are "providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem." These were also the originally proffered twin promises of BDCP/Fix that thus far have not been fulfilled.

As discussed above at section III.C.1., 2015 RDEIR/S further narrows the description of purpose and need. It also eliminates the 90,000 or more acres of habitat restoration and breaks the promise to meet the "gold standard" of a Habitat Conservation Plan and Natural Communities Conservation Plan proffered from the earliest days of the BDCP to assure its environmental benefits.

Left are single-focus giant diversion facilities and conveyance tunnels.[7]

[7] EcoRestore, a recently announced separate program to restore Delta habitat, is little more than a branding effort. Much of the habitat restoration proffered by EcoRestore is merely the implementation of measures already required by federal regulators as a condition of continued operation of the SWP and CVP. These orders are long-standing and EcoRestore does not represent any new, increased, or significant effort to restore Delta habitats or repair the Delta ecosystem.

3. The Lead Agency Arguments Against A Portfolio Alternative Lack Merit.

The arguments against *even considering one* portfolio alternative with even *one* portfolio element are found at 2013 Draft EIR/S Appendix 3A § 3A.11.1.1 at 3A-82–83. This section rejects a call from the Natural Resources Defense Council to consider a portfolio alternative and generally eliminates *any* portfolio approach as well. The principal argument is that portfolio elements are "beyond the scope of an HCP/NCCP focused on the Delta." 2013 Draft EIR/S 3A-81. The first part of this answer, that an HCP/NCCP cannot accommodate portfolio elements, is gone because preferred Alternative 4A is not an HCP/NCCP and the idea of BDCP/Fix qualifying as an HCP/NCCP is, for all practical purposes, dead. The second part, that Fix is focused on the Delta, begs the question and ignores the overwhelming consensus that single-focus in-Delta projects cannot solve the problems of water supply and in-stream ecological needs, which are two sides of the same coin.

The arguments further conflate the call for portfolio-based alternatives with a demand to instantaneously implement the entire California Water Plan. Considering an alternative that includes *some* significant storage is not the same as a demand to solve all of the state's water problems in one fell swoop.

The arguments that "DWR has no control over" local programs, *id.*, and that generally portfolio elements are beyond DWR's reach is also without merit. First, the document and project are joint products of the Lead Action Agencies, DWR *and* Reclamation. The resources of the federal government are available for this project. Second, the elements are within DWR's reach:

a. DWR has no control of *local* water supply and recycling.

The water contractors are integral partners, along with the federal and state governments, in the BDCP/Fix process. They have been voting members of the BDCP steering committee from the beginning—unlike environmental groups that were ex-officio members. *See Planning Agreement regarding the Bay Delta Conservation Plan*, October 6, 2006 (Attachment 10); *see also First Amendment to the Memorandum of Agreement Regarding Collaboration on the Bay Development and Conservation Plan* 7 (2011) (Attachment 11) (parties to support contractors as applicants and permittees along with DWR). Indeed, the contractors are paying hundreds of millions of dollars to fund the BDCP/Fix planning effort. *Id.* at 10. And they *do* have control over local water supply and recycling as well as the money and expertise to implement these programs. The BDCP/Fix federal/state/local partnership is one of extraordinary capacity and opportunity. What better opportunity is DWR waiting for?

b. DWR's support for such supply augmentation cannot transform the BDCP from an incidental take permit focused on the Delta into a broader focus.

The BDCP/Fix is no longer pursuing a section 10 incidental take permit. As we pointed out in our November 16, 2011, comments on the First Amendment to the Memorandum of Agreement, description of the project as "issuance of ESA permits" has never been a legally adequate or factually accurate description of the "major federal action" in any event.

c. Many of the aspects of a portfolio approach can only be accomplished through Integrated Water Management.

"Other reasonable alternatives could be developed by incorporating a suite of measures, including Integrated Water Management." August 26, 2014, EPA Comments 3. *See also* subparagraph a above. What better opportunity to integrate water management on a project-specific basis is DWR waiting for?

D. Including A Portfolio Alternative In The 2015 RDEIR/S Would Avoid The Significant Adverse Environmental Effects/Unmitigated Environmental Impacts Identified In The 2015 RDEIR/S.

1. The Preferred Project And Present Alternatives Have Numerous Adverse Effects That Could Be Eliminated By A Portfolio Alternative.

Among the many adverse effects/unmitigated impacts of the project are the following:

a. Unmitigated Significant Adverse Impact/Effect GW-8: Statewide Long-Term Depletion Of Groundwater Supplies And Interference With Groundwater Recharge / Recharge Opportunities.

Under Alternative 4A surface water deliveries "may decrease by approximately 179 TAF per year depending on the range of spring Delta outflow requirements compared to Existing Conditions. A decrease in surface water deliveries could result in an increase in groundwater pumping and a decrease in groundwater levels, depending on the total water portfolio of the site-specific areas. Therefore, decreases in surface water deliveries would result in significant impacts on groundwater resources under Alternative 4A." 2015 RDEIR/S 4.3.3-8. The "overall impact for Alternative 4A [on groundwater supplies and recharge is] considered significant and unavoidable." *Id.* 4.3.3-8.

b. Significant Unmitigated Adverse Impact/Effect GW-9 Degradation Of Statewide Groundwater Quality.

"If groundwater pumping is increased, there could be resulting changes in regional patterns of groundwater flow and a change in groundwater quality. Due to the uncertainty associated with these effects, this effect is considered adverse. For the same reasons discussed earlier in connection with the possibility of increased groundwater

pumping in Southern California, there is no feasible mitigation available to mitigate any changes in regional groundwater quality." 2015 RDEIR/S 4.3.3-8. Implementation "of Alternative 4A at ELT and LLT could degrade groundwater quality in portions of the Southern California SWP Export Service Areas; this impact is considered significant due to the possibility of increased groundwater pumping and the resulting effects on regional groundwater flow patterns. As discussed above, there is no feasible mitigation to address this significant impact. The impact would be considered significant and unavoidable in these areas." *Id*. 4.3.3-8–9. The "overall impact for Impact Gw-9 Alternative 4A is considered significant and unavoidable." *Id*. 4.3.3-9.

c. Significant Adverse Impact/Effect WQ 11: Increased EC.

"The increase in EC in the Sacramento River at Emmaton, particularly during summer months of dry and critical water years, and the additional exceedances of water quality objectives in the San Joaquin River at Prisoners Point constitute an adverse effect on Water Quality. Mitigation Measure WQ-11 would be available to reduce these effects." 2015 RDEIR/S 4.3.4-28.

"Based on these findings, this impact in the Plan Area is considered to be significant. Implementation of Mitigation Measure WQ-11 would be expected to reduce these effects to a less-than-significant level." *Id*. 4.3.4-30.

Mitigation measure WQ-11, however, would not be applied when it is needed most: in critical water years. "These actions [comprising WQ-11] would not be required in critical water years, when the objective does not apply." 2015 RDEIR/S. This constitutes a significant unmitigated negative impact/adverse effect because it exacerbates an already critical salinity problem when it is at its worst. The "objectives" that do not apply in critical years are SWRCB water quality objectives for salinity. However, regardless of the suspension of these regulatory requirements in critical years because current infrastructure cannot meet both these environmental needs and minimal export needs for the protection of human health and safety, the project *does* have a significant unmitigated effect on the environment. It increases salinity at Prisoners Point, Jersey Point, and Emmaton where it has adverse impacts on Striped Bass and other species.

This negative impact is an inherent part of the project. Changing the points of diversion to the north Delta means that water that would, under existing conditions, flow through the Delta and contribute to dilution of salinity will be diverted before it reaches Delta streams and sloughs and diverted through the tunnels directly to the export pumps. Shifting exports to existing south-Delta diversion points will not reasonably be expected to avoid this impact because south Delta pump operations themselves draw salt water upstream from the bay and contribute to the problem and self-limit the ability to pump from the south Delta location. *See* Attachment 13 hereto.

Further, Mitigation Measure WQ-11 impermissibly defers formulation of the content of the mitigation measure to some future date. "Generally CEQA requires mitigation measures to be formulated in an EIR and not deferred to the development of future plans or measures" that are promised to mitigate impacts. *Center for Biological Diversity v. Dept. of Fish and Wildlife*, 183 Cal. Rptr. 3d 736, 754 (2015). The only

exception is where the deferred mitigation measure provides a performance standard that will be met *and demonstrates that the impact can be mitigated in the manner described. Id.* (emphasis added). The deferred measures must "satisfy specific performance criteria *articulated at the time of project approval." Sacramento Old City Ass'n v. City Council*, 229 Cal. App. 3d 1011, 1028–29 (1991) (emphasis added). WQ-11 relies on commitments to "Adaptively Manage Diversions at the North and South Delta Intakes to Reduce or Eliminate Water Quality Degradation in Western Delta" as well as adaptively managing the head of Old River barrier and north and south Delta intakes to eliminate exceedances at Prisoners Point. 2015 DEIR 4.3.4-30. These measures depend on an impermissibly deferred adaptive management plan. The project proponents have steadfastly refused to articulate how the adaptive management plan will work and have not demonstrated it can be effective. *See* § IV.B below.

d. Significant Adverse Impact/Effect WQ 7: Chloride Concentrations.

"All of the Alternative 4H1-H4 Scenarios would result in increased water quality degradation ... and could contribute measurable water quality degradation relative to the 303[d] impairment in Suisun Marsh ... ." 2015 RDEIR/S 8-226. "Substantial long-term degradation may occur at Antioch under all of the H1-H4 Scenarios ... ." *Id*. 8-227.

However, the NEPA Effects and CEQA Conclusion sections at 2015 RDEIR 4.3.4-18 conclude that there would be no adverse effect or significant adverse impact. These conclusions appear to be based on re-visiting the results of the original modeling and making additional assumptions, providing explanations, and re-visiting metrics. Questionable conclusions include the following:

1) The increase in long-term average chloride concentration at Staten Island would be 25%. 2015 DEIR 4.3.4-13. But this is dismissed as insignificant because it is "extremely small in absolute terms" relative to "applicable water quality objectives." *Id.* However, as discussed at section IV.A.2, existing applicable water quality objectives are recognized as inadequate. Water quality for fish, municipal, and industrial uses suffers harm from excessive chloride concentrations under existing conditions. A 25% increase over existing conditions is an adverse effect and significant impact under these circumstances.

2) "In the Sacramento River at Emmaton, there would be an increase in chloride objective exceedance during the drought period modeled, from 55% to 57% under operations scenario H3, although these changes are within the uncertainty of the modeling approach; there would be no increase in objective exceedances under operations scenario H4." 2015 RDEIR/S 4.3.4-14.

3) Changing assumptions about operations of the Montezuma Slough Salinity Gates. Original modeling assumed the gates would not be operated and showed adverse effects of Alternative 4A on chloride concentrations. When the model was changed to include operation of the gates, the adverse effect was diminished. However, operation of these Gates has its own negative effects and the wisdom of the operating the gates at all has been questioned. The gates "did have a negative effect on salmon passage" and attempts at modifying the gates "did not improve salmon passage at the SMSCG." *Suisun Marsh Salinity Control Gates Salmon Passage Evaluation Report* 1 (DWR and DFG

2003) (Attachment 12). Because of the opaque nature of the environmental documents, it is unknown if the gates were not included in original modeling in anticipation that they would not be operated because of their negative impact on salmon populations in view of recent crashes in salmon abundance. In any event, reliance on gate operation to find no adverse effect was an unreasonable assumption. There is a fair argument that locking gate operation in place to avoid salinity impacts of Alternative 4A itself may have a negative impact on Salmon populations that must be analyzed.

Overall, the finding that there is no adverse effect/significant impact of WQ-11 is not supported.

e. Significant Adverse Effect/Unmitigated Impact WQ-14 Degradation Of Water Quality By Increased Mercury Concentrations.

The Lead Agencies propose wetland creation as mitigation for the loss of wetlands due to project facilities replacing existing wetlands. First, there is no good evidence that "wetland creation" can ever be an adequate replacement for existing wetlands. This is especially true here. Wetland projects that enhance existing wetlands elsewhere create no new wetland areas. Therefore they do not mitigate the destruction of other wetlands for project construction because the wetlands that were destroyed are not replaced and there is a decrease in total wetland area equal to the amount of wetlands destroyed by the project. *See* 2015 ISB DEIR Review 6–7. The idea that wetlands can be created from farmland, other land that is not already a wetland or emergent wetland, or from uplands is highly speculative and unproven. These attempts often end up as mud holes that may look in some respects like a wetland but have little ecological function. This type of wetland creation cannot serve as mitigation for the destruction of wetlands because the outcome is too speculative and theoretical to serve as a concrete mitigation measure. While there may be an offset in the amount of acres of "wetland," there is no evidence that these created wetlands will replace the biological functions of the destroyed wetlands. In fact, evidence is to the contrary. At the very minimum, the ratio of "created" wetlands to destroyed wetlands would have to be very high.

This mercury pollution is an unlawful violation of water quality standards and must be removed from the project because it cannot be justified on the basis that it is a mitigation measure. It is pollution without any justification.

f. Unmitigated Destruction Of Wetlands.

For the reasons discussed in subparagraph e immediately above, the destruction of wetlands for the construction and operation of project facilities remains an adverse effect/significant unmitigated impact.

g. Significant Adverse Effect/Impact WQ32 Microcystis.

The NEPA and CEQA conclusions that Alternative 4A would not have adverse effects is unsupported. "Modeling that adequately accounted for the effects of water conveyance facilities operations and maintenance and the hydrodynamic impacts of the

environmental commitments on long-term average residence times in the six Delta sub-areas was not available for Alternative 4A, so the hydrodynamic effects of this alternative on *Microcystis* were determined qualitatively." This amounts to unjustified speculation driven by a rush to push Alternative 4A to approval. The Lead Agencies have the capacity to do exactly the modeling that was foregone. They have done it for other alternatives, and it showed significant adverse effects. Such modeling is the basis for all the impacts analysis on water quality. Abrupt departure here is suspect.

The Lead Agencies have failed to take the requisite "hard look" at this impact. Taking that look is indisputably within their capacity and it is required to comply with NEPA and CEQA. In its absence, this impact must be considered adverse and significant.

h. Significant Adverse Effect/Impact AQUA-22 Longfin Smelt.

Project operations of Alternative 4A will have an adverse effect on spawning, egg incubation, and rearing habitat for longfin smelt. ES-50. The proposed mitigation measure is "adjustment via adaptive management, which is intended to allow for further evaluation of spring outflow." This is an unlawful deferral of mitigation based on non-existent adaptive management as described at subparagraph c. above and section IV.B below. The impacts on longfin smelt, therefore, must be considered adverse and significant.

i. Significant Adverse Effect/Impact AQUA-78 Chinook Salmon Migration.

This impact is significant. ES-54. The proposed mitigation measure, AQUA-78D, states that "Whenever possible during real-time operations, project proponents will slightly adjust Shasta, Folsom and/or Oroville Reservoir operations to ensure that instream flows are sufficient to minimize or avoid migration-related effects to fall-run Chinook salmon." 2015 RDEIR/S 4.3.7-193. This is an unlawful deferred mitigation as described at subparagraph c. above and section IV.B below. There is no "real-time operations" monitoring or adaptive management mechanism, and all indications are that project proponents either cannot or will not develop one. The preface of "[w]herever possible" is not quantified or analyzed as to when and under what conditions it will be possible.

The impacts on Chinook salmon migration, therefore, must be considered adverse and significant.

j. Significant Unmitigated Impact/Adverse Effect AQUA-201 Striped Bass and American Shad.

This impact is significant and unmitigated for CEQA purposes. ES-59. Entrainment at the new north Delta intakes of early life stage striped bass and American shad would be significant under CEQA and entrainment of early life state American shad would be adverse under NEPA. 2015 RDEIR/S 4.4.7-213–214.

k. Significant Impacts/Effects On Aesthetics And Delta-As-Place.

Construction and operation of the north Delta intakes and associated infrastructure would existentially transform one of the most scenic and iconic sections of the Delta as viewed from both land and water. The industrial character of the facilities and restrictions on boating and land access are incompatible with the Act's requirements to preserve Delta as place and respect existing land uses. Under these circumstances these impacts are significant and adverse for purposes of NEPA and CEQA.

l. Adverse Environmental Impacts On Recreational Navigation Of The Head Of Old River Barrier And Violation Of Federal Statutory Navigability Requirements.

Making the head of Old River barrier a permanent engineering structure is a significant change in the physical environment and makes a temporary seasonal (although longstanding) impairment to recreational boating permanent.

The severe negative impact on boaters of barriers to recreational navigation is documented in the comments we submitted to Lead Agency DWR on March 18, 2015, with regard to their proposed Emergency Drought Barriers Project (Attachment 13). Our Drought Barrier Comments also point out that barriers to recreational navigation violate the act of Congress admitting California to the union, which requires keeping "all navigable waters within the said State shall be common highways, and forever free." This barrier and the cumulative impact of the many barriers proposed at various locations by the Lead Agencies and others violate this act of Congress. *See* 9 Stat. 453 (1850).

Those comments are incorporated here and apply equally to this barrier. The many letters from boaters objecting to barriers to recreational navigation attached to our Drought Barrier Comments are worth perusal.

This is a significant impact/adverse effect that must be analyzed, avoided, or mitigated.

2. Alternatives Containing One Or More Portfolio Element Would Avoid/Eliminate/Mitigate To A Level Of Insignificance The Adverse Effects.

Enhancing in-Delta flows by providing new water while at the same time taking pressure off of groundwater supplies and providing new water could eliminate the adverse water quality and groundwater impacts described above. By providing new water, the portfolio approach would also allow reduction or elimination of massive new infrastructure in the most scenic part of the Delta that damages the Delta as place and impairs recreational boating and other recreation. This could eliminate impacts k and l described above. New water also allows more flexibility in diversions that could eliminate impacts.

Providing more flow in the Delta is the key to restoring the Delta ecosystem. Providing new water allows more flow to remain in the Delta because it provides a substitute for drawing down Delta flows as a source of supply.

The impacts listed in sections 1a–j above could be eliminated by including one or more of the portfolio elements listed at section II.C. Providing additional groundwater recharge capacity through modest new infrastructure in the Southern California, which could use water available at times of surplus (perhaps in conjunction with new north of Delta surface storage), would eliminate adverse effects GW-8 and GW-9. The Water Replenishment District of Southern California engages in groundwater recharge. *See generally Water Replenishment District of Southern California Engineering and Survey Report,* March 5, 2015 (Attachment 14). Agencies like WRPDSC provide partners for eliminating the adverse effects of GW-8 and GW-9 through increased recharge. Providing surface storage by itself would also eliminate adverse effects GW-8 and GW-9 because it would provide water supplies alternative to further drawing down already depleted aquifers.

Surface storage and groundwater recharge would also eliminate adverse effects WQ-7 and WQ-11 because "new water" available from groundwater recharge and/or surface storage would replace water drawn from Delta flows, leaving more water available for in-stream flow. It is the reduction in freshwater flows that causes increases in EC and chloride concentrations. For example, installation of the Suisun Marsh Salinity Gates was mitigation for impacts of the SWP and CVP diminishing freshwater flows in the first place. *See, e.g.,* Chris Enright, DWR, *Suisun Marsh Salinity Control Gate: Purpose, Operation, and Hydrodynamics/Salinity Transport Effect* 3 (Attachment 15).

Conservation creates new water to replace water inappropriately drawn from Delta flows at times when there is inadequate flow to support both exports and in-stream needs.

Integrated Water Management allows the coordination of local, regional, and statewide supplies. It allows water to go where it is needed most when it is needed most from the least environmentally harmful means of supply. The CVP and SWP systems, along with interconnected regional canals, link the water management districts of concern in almost all of California in a "water internet." Many of the water management districts of concern are already BDCP/Fix partners. Why not use this partnership to implement Integrative Water Management *for this project*?

A multi-focus solution alternative can have a new point of diversion as its major (or a major) element. The new point of diversion could be located exactly where the Alternative 4A point of diversion is located. The alternative could retain the current design of the twin tunnels. *Addition* of *some* complimentary component that would alleviate the adverse impacts by working *in conjunction with the tunnels* would satisfy the legal requirements of NEPA and CEQA. We are not asking the Lead Agencies to give up their project or pursue a radically different alternative. We are asking them to take a hard look at an alternative that fills the critical gaps in all of the currently proposed alternatives and preferred project, and makes the project work.

Development and consideration of such an alternative is all the more imperative in light of the failure of BDCP's habitat restoration component.

It was thought by BDCP proponents that massive amounts of new shallow-water habitat would provide enough ecological benefit to allow for diversion of more water

without net damage to the ecosystem. The entire BDCP was premised on the assumption that habitat could be substituted for flow. In essence, BDCP visionaries theorized that habitat restoration would be a source of "new water." The intensive investigation and modeling of this assumption, at a cost of tens of millions of dollars over six years, proved that it doesn't work. It was worth a try but it doesn't work. Now what?

The answer is to refine the project by including sources of new water that are already *proven* to work. The law and common sense demand that the Lead Agencies at least develop and consider such an alternative before making a decision to either abandon the whole effort through adoption of the no-action alternative or adopt a project that has severe negative environmental consequences *and* falls far short of the aspirations of project proponents.

Integration of a portfolio approach could well resuscitate the dream-come-true of an HCP and the attendant fifty-year take permit that the Action Lead Agencies and contractors desire.

E. Screening Alternative 9A Was Unreasonably Eliminated And The 2015 RDEIR/S Should Include A Detailed Analysis Of Alternative 9A.

The 2010 SWRCB Flow Criteria Report, commissioned by the California Legislature for use in making BDCP planning decisions, concluded that restoration of 75% of unimpaired Delta flow was the minimum needed to protect public trust resources. This finding deserves serious consideration. However, the Lead Agencies have dismissed attaining 75% of unimpaired flow and further dismissed *any* percentage of unimpaired flow as a metric for the preferred Alternative.

Summarily dismissed screening Alternative 9A was the only alternative addressing attainment of 75% of unimpaired flow.

Although the confused presentation of materials makes it difficult to discern with any certainty the Lead Agencies' reason or reasons for eliminating alternatives from detailed consideration, it appears that Alternative 9A was eliminated because 1) "based upon preliminary model analysis, both of these alternatives [Alternatives 8A and 9A] would result in reductions in water deliveries to [upstream] Sacramento River water rights holders in order to achieve the flow and water quality objectives in these operations alternatives," 2013 Draft EIR/S App. 3A table 3A-17 at 3A-150; and 2) "preliminary modeling analysis indicates that Delta outflow criteria could not be accomplished even with reducing deliveries to upstream water rights holders." *Id*. App. 3A table 3A-14 at 3A-148. The Lead Agencies further argue that "[r]educed water diversions from these water rights holders cannot be feasibly accomplished through approval of the BDCP [because] these water rights holders are not applicants for the BDCP." *Id*. 2013 App. 3A 3A-68.

First, DWR has, in important past agreements, paid upper Sacramento Valley water rights holders for forgoing use of their rights on a per acre-foot basis so DWR could meet its environmental in-stream flow obligations and water supply goals. Phase 8 Settlement Agreement 14–15 (Attachment 16). DWR has also agreed to share costs with upstream rights holders to help them develop new local projects to provide new water and allow more in-stream flow—available downstream to DWR for meeting environmental obligations and water supply goals. *See* Phase 8 Settlement Agreement *passim.* The Phase

8 settlement is closely related to the *Sacramento Valley Water Management Agreement* (Attachment 17), a partnership between DWR, Reclamation, upstream Sacramento River water rights holder, the water contractors, and others.

Indeed, Alternative 4A itself depends upon "spring outflow criteria, which are intended to be provided through the acquisition of water from willing sellers." 2015 RDEIR/S 4.1-6. A significant restoration of Delta flows, including a successful BDCP/Fix, may involve similar agreements and acquisitions in the future. Dealing appropriately and lawfully with upper Sacramento River water rights holders and other upstream diverters is feasible and may be part of a reasonable alternative that is based on achieving a percentage of unimpaired flow. The impairment-of-upstream-rights reason provided for summarily dismissing Alternative 9A was not reasonable.

Second, the flow objectives could be met in a phased approach over time. Achievement of 75% of unimpaired flow might take 20 years or more as a BDCP/Fix portfolio alternative is implemented. In considering the environmental effects of its proposed actions, Congress directed all federal agencies to consider "the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity." 42 U.S.C. § 4332(C)(iv). The Lead Agencies have summarily dismissed screening Alternative 9A based on local short-term uses of upper Sacramento Valley water rights holders and failed to consider resolving short-term considerations in light of the need for long-term ecological productivity of the Delta ecosystem. Achievement of 75% of unimpaired flow (or any percentage of unimpaired flow) does not have to happen on project ribbon-cutting day. Project milestones could include, for example, 60% within five years of project operation, 65% within ten years, 70% within 20 years, 75% within 25 years; or any other phased implementation of some ultimate percentage of unimpaired flow *as determined through detailed analysis as part of a portfolio alternative.* The BDCP was conceived as a fifty-year plan. These time horizons are reasonable in light of the project description, purpose, and need.

Unimpaired flow as a metric of achieving restoration of restored Delta flows deserves further consideration in light of the findings of the Flow Criteria Report:

> In order to preserve the attributes of a natural variable system to which native fish species are adapted, many of the criteria developed by the State Water Board are crafted as percentages of natural or unimpaired flows. These criteria include:
>
> - 75% of unimpaired Delta outflow from January through June;
> - 75% of unimpaired Sacramento River inflow from November through June; and
> - 60% of unimpaired San Joaquin River inflow from February through June.

Flow Criteria Report 5.

The current Fix approach of Alternative 4A to Delta flows, measuring bypass flows at the new point of diversion, is not consistent with the Flow Criteria Report or the California Legislature's directive to restore Delta flows (discussed at section IV. below).

Bypass flows were not the metric developed to protect public trust resources and do not address restoring natural Delta flows.

We do not suggest, and have never suggested, that the Lead Agencies are required to adopt the Flow Criteria Report as the flow requirements for BDCP/Fix. It is an informational document and was prepared for the SWRCB by an independent panel of eminent Delta scientists. We do suggest that it is due considerable regard rising to the level of further consideration as part of an alternative that starts out by including the elements, in addition to conveyance, that will be required to implement it and not disrupt water supply or other environmental needs. Such elements might include any of the portfolio elements as discussed herein and/or modifications, such as an unimpaired flow+ alternative, just as Alternative 4A depends upon an H3+ operational scenario.

In this light, Alternative 9A (or its derivative(s)) should be given full consideration in a further revised RDEIR/S.

IV. Preferred Alternative 4A Does Not Comply With The Delta Reform Act.

A. On The Whole, Alternative 4A Does Not Advance The Coequal Goals And, In The Long Term, Hinders Achievement Of The Coequal Goals.

1. The Coequal Goals And Inherent Sub-goals Apply To BDCP/Fix.

The Delta Reform Act ("Act") requires that all state agencies conform their actions to the Act's coequal goals, which are the pole star of Delta policy. The coequal goals are "providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem." Cal. Water Code § 85054. Inherent in the coequal goals are the subgoals of "[r]estor[ing] Delta flows and channels to support a healthy estuary and other ecosystems," Cal. Water Code § 85302(e)(4), and "[i]mproving water quality to meet drinking water, agriculture, and ecosystem long-term goals." Cal. Water Code § 85302(e)(5). That these requirements apply to the BDCP/Fix is not in dispute.

2. Alternative 4A Does Not Restore Delta Flows Or Protect Public Trust Resources Within the Meaning Of The Act.

The Act provides that "the public trust doctrine shall be the foundation of state water management policy and [is] particularly important and applicable to the Delta." Cal. Water Code § 85023. Restoring and maintaining adequate Delta flows is the cornerstone of meeting public trust obligations with respect to Delta water management policy.

Alternative 4A relies, in large measure, on extant standards in the SWRCB 2006 Bay-Delta Water Quality Control Plan as implemented through Water Rights Decision No. 1641 ("D-1641"). *See, e.g.*, 2015 RDEIR/S 4.1-9 n.17 ("an alternative operation for spring outflow would be to follow flow constraints established under D-1641"); *see also id.* at 4.1-10–12. However, it has been established that D-1641 standards are inadequate to protect public trust resources. The Flow Criteria Report, commissioned explicitly to

guide the Lead Agencies in this regard, concludes that "[r]ecent Delta flows [as controlled by] ... existing regulatory requirements included in the 2006 Bay-Delta Plan are insufficient to support native fishes for today's habitats." Flow Criteria Report 5 & n.3. *See also* Delta Plan 148 ("The best available science suggests that currently required flow objectives within and out of the Delta [D-1641] are insufficient to protect the Delta ecosystem.").

In many respects, the NEPA and CEQA conclusions of no adverse effect/significant impact are based on the project not violating applicable laws and regulations with respect to water quality, even though the project admittedly causes some water quality degradation.

Of the thirty-five water quality impacts listed for Alternative 4A in Table ES-9, none is listed as "beneficial" although the table key provides for a beneficial listing. 2015 RDEIR/S ES–45. One is listed as adverse/significant. We believe many more water quality impacts are actually adverse, including, but not limited to impacts WQ-11 and WQ-7, discussed above. Even on the project proponents reckoning, the project has net negative effect on water quality.

Water quality is a function of flow. The project's failure to restore Delta flows causes its failure to improve water quality.

3. The Benefits, If Any, To OMR Reverse Flows And Delta Smelt Entrainment, Are Outweighed By The Project's Negative Effects.

The impetus for new points of diversion in the north Delta is to move the diversion points away from Delta smelt habitat areas so operations can continue when smelt are in the area of the south Delta intakes. Further impetus is to avoid the limiting effect of reverse OMR flows on the ability to pump. Regulatory restrictions and the self-limiting factor of drawing salt water upstream limit operations of the south Delta pumps.

There are incidental environmental effects of these water supply goals. However, the many negative impacts of the project far outweigh any incidental positive effects. Further, according to the most recent analysis of Alternative 4A, it does not significantly contribute to water supply reliability if operated as promised.

The project, on the whole, does not contribute to the coequal goals and has many attributes that will interfere, over the long term, with attaining the coequal goals.

B. Alternative 4A And All The Alternatives Fail To Comply With The Act Because They Lack Adaptive Management.

California Water Code section 85321 requires that the "BDCP shall include a transparent, real-time operational decisionmaking process in which fishery agencies ensure that applicable biological performance measures are achieved in a timely manner with respect to water system operations." Rebranding the project as California WaterFix and deleting 65,000 or more acres of habitat restoration does not repeal section 85321. Legislative intent was to protect the Delta from a mega-diversion project gone awry. The Lead Agencies have acknowledged, throughout the process, that effective adaptive management is essential to ensuring that high-capacity diversion tunnels do not harm the

Delta ecosystem. Revising the project description to delete the goal of achieving HCP status does not change that dynamic. An effective, fully developed and described, adaptive management program is essential to the legal sufficiency of Alternative 4A and to any claim to the scientific legitimacy of the effects analysis, operational criteria, and environmental review documents. Practice in the scientific community (which develops and implements adaptive management programs) has been to interpret the Act's adaptive management requirements to required "science-based adaptive management of all ecosystem and water management programs in the Delta." *Mount Report* 99 (citing Cal. Water Code § 85308(f)).

Indeed, much of Alternative 4A's commitment to not harming the Delta ecosystem depends on, and is deferred to, adaptive management. The Lead Agencies acknowledge a great deal of scientific uncertainty about Alternative 4A's effects on the Delta ecosystem, and depend upon adaptive management to ensure mitigation of adverse effects. Adaptive management "will be used to consider and address scientific uncertainty regarding the Delta ecosystem and to inform implementation of the operational criteria ... ." 2015 RDEIR/S4.1-6.

At bottom, all of the EIR/S assumptions about environmental impacts depend on effective adaptive management. However, Alternative 4A's (like the BDCP's) adaptive management is largely a repetition of slogans about what adaptive management should be. Despite sustained outcry from the scientific community and the public about the Lead Agencies' chimerical treatment of adaptive management, the documents remain an exercise in specious deflection of calls for a real adaptive management program. As the ISB put it, "We are not looking here for a primer on adaptive management." 2015 ISB DEIR Review 5. The project's "missing content includes: 1. Details about the adaptive-management process, collaborative science, monitoring, and the resources that these efforts will require." *Id*. 1. Further:

> The lack of a substantive treatment of adaptive management in the Current Draft indicates that it is not considered a high priority or the proposers have been unable to develop a substantive idea of how adaptive management would work for the project.

Id. 5.

The current state of vacuity in adaptive management is the progression of a process that sought to *frustrate* the ability of adaptive management to throttle back exports through the high-capacity tunnels no matter how dire or immediate the harm to the Delta ecosystem. From the outset, the regulated entities, including the water contractors whose self-interest is to derive as much water as possible from the Delta, have been given an illegitimate role in adaptive management. *See, e.g.*, *Mount Report* 100 (commenting on 2013 Administrative Draft) (noting that the adaptive management structure "confuses the roles of regulators and regulated entities" and will likely result in "rendering the concept of adaptive management moot"); *see also id.* at 83 (noting that adaptive management "is undermined by provisions in the draft Plan that grant the Authorized Entity Group [water contractors]—rather than regulatory agencies—veto authority over changes to the conservation measures [including CM1, operation of the

tunnels themselves], biological objectives, and adaptive management strategies, as well as over amendments to the BDCP itself").

The water contractors, mentioned in the *Mount Report* as being given veto authority over any change in the initial operating criteria that sets export rates, characterize the "need to restore adequate water supplies to protect the state's environmental resources" as "throwing more water at the problem." Letter from Byron Buck, Executive Director, State and Federal Water Contractors Association to Phillip Isenberg, Chairman, Delta Stewardship Council 1, March 3, 2011 (Attachment 18).

To be legally sufficient, the adaptive management program must be fully formed and circulated for public comment before any decision is made to approve the project. It cannot be deferred to some future time after project approval. "If adaptive management and monitoring are central to California WaterFix, then details of how they will be done and resourced should be developed at the outset (now) so they can be better reviewed, improved, and integrated into related Delta activities." 2015 Delta ISB Review 6.

The Act and Delta Plan require that all water management decisions be based on adaptive management and that adaptive management be based on the best available science. "The Delta Reform Act requires that the Delta Plan be based on and implemented using the best available science, and requires the use of science-based, transparent, and formal adaptive management strategies for ongoing ecosystem restoration and water management decisions." Delta Plan 34. The Lead Agencies stated that reliance on adaptive management would be "based on best available science" but have deferred any content of adaptive management to the future. 2013 Draft EIR/S 3-207.

Every scientific peer review that has been conducted of the adaptive management "plan" concludes that it is not an adaptive management plan as that term is used in the scientific community, but rather a vague promise for a future adaptive management plan. These promises, rather than an actual plan, all reviewers have concluded, are not acceptable. There is consensus in the scientific community that the Lead Agencies' deferral of adaptive management violates the principles of best available science.

V. The Change In The Project Is Too Fundamental To Be Accomplished Through An Amended Project Description And Requires Issuance Of A New NOI/NOP.

All of alternatives 1–9 described in the 2013 Draft EIR/S were HCPs. The changed project description is intended to eliminate any HCP from the project. This is a different project, not a permissible change or "lessening" of the project. Those cases that allow a changed project description to "lessen" a project do so on the rationale that the environmental balance is thereby tipped in favor of the environment. A smaller project has fewer and less severe impacts.

Here, the opposite is the case. The conservation "gold standard" of an HCP, promised to the public from the outset, has been abruptly abandoned. This tips the balance sharply against the environment and in favor of outright water diversion without any real environmental benefit. The current project description and alternatives that include mitigations and "environmental commitments" are not of the same basic nature as the original project.

If project proponents want to pursue this entirely different kind of project, they are, of course, at liberty to do so—so long as they comply with CEQA and NEPA by issuing a new NOI/NOP and initiating a NEPA/CEA process for this new and different undertaking.

VI. We Join With And Incorporate The Comments Of Others.

We agree with many of the comments being made, and that have been made, by other parties. We do not repeat them here. Repetition of other comments is not necessary to exhaust remedies for purposes of NEPA and we join and incorporate the comments of others that address CEQA/NEPA inadequacies for the purpose of exhausting NEPA administrative remedies. Exhaustion is satisfied because the agencies are on notice of our concerns and they have had a chance to address them in detail by their detailed presentation in the comments of others. Where we use CEQA terminology here, the NEPA equivalent terminology is also intended to be included. We join other commenters' criticisms including the inadequacy of mitigations; undisclosed or unanalyzed impacts; the failure to consider a reasonable range of alternatives; the unstable project description; the false, misleading, and inadequate project description; failure to adequately define baseline conditions; failure to analyze secondary effects; failure to describe and evaluate reasonable and feasible mitigation measures that could eliminate or substantially lessen significant environmental impacts of the project; unlawful segmentation and deferral of environmental review (piecemealing).

We also join with and incorporate the comments of others pointing out that the project and environmental documents do not comply with the Delta Reform Act, state and federal endangered species acts, the federal Clean Water Act, and the Porter Cologne Water Quality Control Act.

VII. State Funds May Not Be Used For Anything Associated With The Project.

This is in part a comment on the project, in part a comment on the Draft BDCP and in part a comment on the RDEIR/S.

California Water Code section 85320(b) provides that:

> The BDCP shall not be incorporated into the Delta Plan *and* the public benefits associated with the BDCP shall not be eligible for state funding, unless the BDCP does all of the following:
>
> (1) Complies with Chapter 10 (commencing with Section 2800) of Division 3 of the Fish and Game code.

Chapter 10 provides the specifications required to qualify as an NCCP. Alternative 4A does not qualify as an NCCP. It is therefore ineligible for *any* state funding.

The BDCP provides that much funding comes from the water contractors. 2013 Draft BDCP 8-65. However, state funding is shown for aspects of public benefits associated with the BDCP. *Id*. 8-65–8-69. These funding assumptions were made at a time when it was thought that the BDCP would comply with Chapter 10. They are now

void. A revenue bond is a bond secured by specific revenue—here it was thought the revenue would be payments from the water contractors based, at least in part, upon water deliveries. This constitutes state funding within the meaning of Water Code section 85320(b)(1) and is now impermissible.

2013 Draft BDCP section 8.3.3 discusses the issuance by DWR of revenue bonds, to be repaid over time by the water contractors. This is no longer permissible. State funding is prohibited, regardless of whether it is provided with agreements for repayment.

It is unclear how Alternative 4A will be funded, but state funds may not be used. Rebranding the project, revising the project description, and re-circulating the environmental documents does not make it a "new" or "different" project within the meaning of Water Code section 85320. Project proponents could adopt the no-project alternative and start a new project with whatever funding sources are appropriate. But they have elected not to do that.

To the extent that mitigations or environmental commitments are premised on state funding, they are inadequate and cannot be relied on for environmental analysis.

VIII. Conclusion.

We thank the Lead Agencies for the opportunity to present these comments and for considering our views.

Sincerely,

/s/Michael A. Brodsky
Michael A. Brodsky

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REGIONAL ADMINISTRATOR

Aug 26, 2014

Will Stelle, Regional Administrator
West Coast Region National Marine Fisheries Service
650 Capitol Mall, Suite 5-100
Sacramento, CA 95814

Subject: Draft Environmental Impact Statement for the Bay Delta Conservation Plan, San Francisco Bay Delta, California (CEQ# 20130365)

Dear Mr. Stelle:

The U.S. Environmental Protection Agency has reviewed the Bay Delta Conservation Plan (BDCP) Draft EIS pursuant to the National Environmental Policy Act (NEPA), Council on Environmental Quality regulations (40 CFR Parts 1500-1508), and our NEPA review authority under Section 309 of the Clean Air Act. The Draft EIS explores options for a comprehensive conservation strategy to restore and protect the Sacramento–San Joaquin Delta's ecosystem health, water supply, and water quality.

As you know, the San Francisco Bay/Sacramento-San Joaquin Delta Estuary is one of the largest and most important estuarine systems on the Pacific Coast of the United States, supporting over 750 species. It is the hub of California's water distribution system, supplying drinking water to 25 million people and irrigation water to 4 million acres of farmland. The decline of aquatic resources in the Estuary, along with the corresponding impacts on urban and agricultural water districts that rely on water exported from it, present significant challenges. Recent circumstances have only underscored the importance of working together on these issues, as California is experiencing severe drought and water shortages. We believe the NEPA process is well-suited to bring all of these considerations together, including the consideration of the environmental impacts of reasonable alternatives to the BDCP as it is currently proposed. We appreciate the effort to prepare the Draft EIS, and we support your recent decision to prepare a Supplemental Draft EIS to take a closer look at these issues.

EPA fully supports the stated purpose of the BDCP effort: to produce a broad, long-term planning strategy that would meet the dual goals of water reliability and species recovery in this valuable ecosystem, and we recognize the potential benefits of a new conveyance facility. However, we are concerned that the actions proposed in the Draft EIS may result in violations of Clean Water Act water quality standards and further degrade the ecosystem.

Our comments are consistent with those we have made in conversations that have taken place over the last few years among the agencies involved in managing the Delta. Many of our comments have also been made by others, both formally and informally, throughout the process, and we believe that they reflect a developing consensus within the scientific and regulatory communities. We are committed to continuing to work with you and other stakeholders toward a project proposal that meets the dual goals

of water reliability and species recovery in the Bay Delta, and toward a well documented EIS that adequately informs decision-makers and the public, as required by NEPA.

Clean Water Act Water Quality Standards

The Draft EIS shows that operating any of the proposed conveyance facilities, which constitute Conservation Measure 1 (CM1), would contribute to increased and persistent violations of water quality standards in the Delta, set under the Clean Water Act, measured by electrical conductivity (EC) and chloride concentrations. We recommend that the Supplemental Draft EIS include one or more alternatives that would, instead, facilitate attainment of all water quality standards in the Delta. Specifically, we recommend that an alternative be developed that would, at minimum, not contribute to an increase in the magnitude or frequency of exceedance of water quality objectives, and that would address the need for water availability and greater freshwater flow through the Delta. Such an alternative should result in a decrease in the state and federal water projects' contributions to the exceedance of any water quality objectives in the Delta.

We also note that, while CM1 would improve the water quality for agricultural and municipal water agencies that receive water exported from the Delta, water quality could worsen for farmers and municipalities who divert water directly from the Delta. In that regard, we recommend that the Supplemental Draft EIS consider measures to ensure that the project would not increase concentrations of bromide around the intake for the North Bay Aqueduct at Barker Slough. In addition, we recommend consideration of whether additional measures, such as operational modifications both upstream and downstream, are needed to avoid increasing mercury and selenium concentrations and bioavailability in the Delta.

The Draft EIS indicates that CM1 would not protect beneficial uses for aquatic life, thereby violating the Clean Water Act. Total freshwater flows will likely diminish in the years ahead as a result of drought and climate change. Continued exports at today's prevailing levels would, therefore, result in even lower flows through the Delta in a likely future with less available water. We recommend that the Supplemental Draft EIS consider modified operational scenarios for CM1 alternatives that would have beneficial effects on covered fish populations during all life stages and attain water quality standards in the Bay Delta.

Habitat Restoration

The Draft EIS describes a general proposal to restore approximately 150,000 acres of wetlands, uplands, grasslands, and riparian areas in and around the Delta to offset the adverse impacts of the continued operations of the water projects. However, the Draft EIS does not indicate whether suitable acreage is available or whether restoration alone would be sufficient to recover fish populations. We are concerned over the sole reliance on habitat restoration for ecosystem recovery, recognizing that existing freshwater diversions and significantly diminished seaward flows have played a significant role in precluding the recovery of Bay Delta ecosystem processes and declining fish populations. We recommend that the Supplemental Draft EIS consider measures to ensure freshwater flow that can meet the needs of those populations and the ecosystem as a whole, and is supported by the best available science. We recommend that this analysis recognize the demonstrated significant correlations between freshwater flow and fish species abundance. We also recommend that the Supplemental Draft EIS include gradients of partial success for each habitat type to be restored, as supported by available science. The impacts

could be re-evaluated relative to each alternative (CMs2-11) in light of these gradients and the likely success rates for each habitat restoration type.

Alternatives

The Draft EIS defines the alternatives in terms of the design and capacity of the proposed conveyance structure. Each alternative is paired with a particular operational scenario. EPA agreed with this organizational construct early in the BDCP process, expecting that the Draft EIS would present a range of fully evaluated alternatives that clarifies the environmental and water supply tradeoffs being considered. The Draft EIS, however, focuses primarily on Alternative 4. It appears that the environmental impacts of certain other alternatives would be reduced if those alternatives were matched with more optimal operational criteria (for example, Alternative 5 with Operational Scenario F). Other reasonable alternatives could be developed by incorporating a suite of measures, including Integrated Water Management, water conservation, levee maintenance, and decreased reliance on the Delta.[1] Such alternatives would be consistent with the purpose and need for the project, as well as with the California Bay Delta Memorandum of Understanding among federal agencies[2] and the Delta Reform Act of 2009.

Project-level Analysis

The Draft EIS states that it includes a *project-level* analysis of environmental effects associated with CM1 (the conveyance facilities, which define the alternatives), and a *programmatic-level* analysis of 21 other Conservation Measures, including a suite of habitat restoration and aquatic stressors management initiatives. Programmatic-level inputs were used in some of the "project-level" analyses. We recommend that the Supplemental Draft EIS include project-level information and analyses for the conveyance tunnels, including the information necessary for permit decisions, to support the federal decision.

Upstream/Downstream Impacts

The federal and State water management systems in the Delta are highly interconnected, both functionally and physically. The Draft EIS does not address how changes in the Delta can affect resources in downstream waters, such as San Francisco Bay, and require changes in upstream operations, which may result in indirect environmental impacts that must also be evaluated. We recommend that the Supplemental Draft EIS include an analysis of upstream and downstream impacts.

NEPA Effects Determination

The Draft EIS presents *NEPA Effects Determinations,* but does not describe the decision rules that were used to make those determinations from the analytical information presented for each impact category. We recommend that the *NEPA Effects Determinations* and thresholds -- quantitative when possible – be provided for each category so that it is clear why some estimated impacts result in one *NEPA Effects Determination* over another. We also recommend that the Supplemental Draft EIS explain whether all metrics are considered equal in the analysis or some are weighted. Please clarify whether negative impacts in one metric category translate into an adverse determination, regardless of the other metrics. Lastly, it would be helpful to include summary tables for each impact category so that the public and decision-makers can understand the metrics and their results and how they compare among alternatives.

[1] The "Portfolio Approach" developed by a diverse set of stakeholders is one attempt to place Delta water management into the larger context of facilities investments and integrated operations. http://www.sdcwa.org/sites/default/files/files/news-center/top-issues/portfolio-based-bay-delta-conceptual-alternative_1-16-13.pdf

[2] http://www2.epa.gov/sites/production/files/documents/baydeltamousigned.pdf

Adaptive Management

The Draft EIS explains that the adaptive management program is a work in progress. The specific approach for an adaptive management program and its effect on environmental consequences is fundamental to the success of the BDCP and should be addressed during the NEPA process. We recommend that a more detailed adaptive management program be provided in the Supplemental Draft EIS, since the goal of species recovery relies significantly on an effective adaptive management program. As you develop the plan, include detailed information on the plan's objectives, explicit thresholds, alternative hypotheses, responsive actions, and designated responsible parties.

Conclusion

EPA remains committed to working with the federal and state lead agencies to develop an environmentally sound, scientifically defensible, and effective plan for restoring the Bay Delta ecosystem and achieving greater water supply reliability. Please note that, because you are preparing a Supplemental Draft EIS, which we anticipate will address many of the issues raised about this Draft EIS, including the issues we have outlined here, EPA will defer our rating until the Supplemental Draft is circulated for public review and comment. We have also enclosed more detailed comments and recommendations for your consideration.

We are available to discuss our comments and recommendations. Please send one hard, and one electronic, copy of the Supplemental Draft EIS to this office at the same time it is officially filed with our Washington D.C. Office. If you have any questions, please contact me at 415-947-8702. Alternatively, your office may contact Kathleen Johnson, Enforcement Division Director. Ms. Johnson can be reached at 415-972-3873.

Sincerely,

/S/

Jared Blumenfeld

Enclosure

cc: Ren Lohoefener, Regional Director, Pacific Southwest Region, U.S. Fish and Wildlife Service
David Murillo, Regional Director, Mid Pacific Region, U.S. Bureau of Reclamation

U.S. EPA DETAILED COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE BAY DELTA CONSERVATION PLAN; AUGUST 25, 2014

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I. Water Quality Impacts

A. Adverse Impacts

Chapter 8 indicates that all project alternatives would result in adverse, significant, unmitigated effects to water quality and one or more beneficial uses within the affected water bodies. For example:

- The proposed changes in water management would measurably exacerbate impairment of agricultural and aquatic life beneficial uses in the South Delta and Suisun Marsh (p. 8-439);
- Bromide, chloride, dissolved organic carbon, and electrical conductivity (EC) are expected to increase due to changes in hydrodynamics as a result of the implementation of the CM1 Alternative 4 (pp.8-420, -428, -454, and -439). In addition, the feasibility of mitigation actions for EC is uncertain (p. 8-441); therefore, the net effect to overall salinity levels is unclear;
- Mercury, pesticide, and selenium exposure levels may increase and be cumulatively significant (p. 8-446, -767, -768); and
- Water quality degradation resulting from the increased pumping of freshwater from the North Delta could cause increases in water treatment costs (p. 8-420).

All Bay Delta Estuary waters are impaired due to numerous contaminants, including pesticides, manufacturing compounds, metals (including selenium), pathogens, nutrients/low dissolved oxygen, invasive species, salinity, and toxicity from unknown sources. Without adequate mitigation, these impairments would be exacerbated by any of the alternatives evaluated in the Draft EIS. Poor water quality in the Bay Delta Estuary and its tributaries adversely affects terrestrial and aquatic ecosystems, drinking water, recreation, industry, agriculture, and the local, state, and interstate economy.

Recommendation: *Discuss mitigation measures that would reduce the projected adverse impacts on water quality, and discuss whether the proposed actions would contribute to impairments of beneficial uses or further degrade water quality.*

B. Salinity (Electrical Conductivity, Chloride) and Bromide

1. Water Quality Standards Exceedances and Degradation

The Bay Delta Water Quality Control Plan (WQCP) contains EC objectives for the Delta to protect agricultural and fish and wildlife beneficial uses, and chloride objectives to protect municipal and industrial water supply beneficial uses. Bromide, a significant precursor to brominated disinfection byproducts, is subject to CALFED Drinking Water Program goals (p. 8-42). The Draft EIS estimates that EC, chloride and bromide concentrations would increase under CM1 Alternative 4, relative to the No Action Alternative and Existing Conditions for Delta locations. The document predicts increased exceedances of numeric water quality standards, which suggests that CM1 Alternative 4 would result in a loss of protection for municipal, agricultural, and aquatic life beneficial uses. Specifically, CM1 Alternative 4 would result in:

- A 17% increase in days out of compliance with the agricultural EC standard at Emmaton (p. 8-252 lines 6-7). The EC objective at Emmaton is intended to protect agricultural beneficial uses, but also has ancillary benefits to aquatic life. Increasing noncompliance days would further contribute to existing EC water quality impairments in the western Delta, and degrade beneficial use protection for agricultural and aquatic life beneficial uses.

- A 7% increase in days exceeding the municipal chloride standard (250 milligrams per liter (mg/L) mean daily maximum) at Contra Costa Canal Pumping Plant #1 (p. 8-243 line 26) and "substantial degradation during the months October through December when average concentrations would be near, or exceed, the objective" (p. 8-243 lines 33-34 and Appendix 8G, 27 Table Cl-9).

- A doubling of the frequency of exceeding the lower municipal chloride standard at Antioch and Contra Costa Canal Pumping Plant #1: "All of the Alternative H1-H4 Scenarios would result in substantially increased chloride concentrations in the Delta such that frequency of exceeding the 150 mg/L Bay-Delta WQCP objective would approximately double" compared to Existing Conditions (p. 8-429) and the No Action Alternative (Appendix 8G Table Cl-64).

- Increased EC levels in Suisun Marsh, exacerbation of the existing EC water quality impairment, and degradation of aquatic life beneficial use protection (p. 8-438 and Appendix 8H-27). "The most substantial EC increase would occur at Beldon Landing with long-term average EC levels increasing by 1.3-6.0 milliSiemens per centimeter (mS/cm), depending on the month and operations scenario, at least doubling during some months the long-term average EC relative to Existing Conditions" and the No Action Alternative (p. 8-438).

- Higher quality water to those receiving the exported water, but adverse impacts on those who rely on water directly from the Delta: "the operations and maintenance activities under Scenario H1-H4 of Alternative 4 would cause substantial degradation to water quality with respect to bromide at Barker Slough… and could necessitate changes in water treatment plant operations or require treatment plant upgrades" (p.8-420).

The EC and chloride analyses in the Draft EIS provide some confusing results. For example, the 16-year average EC concentration (mass balance) at Emmaton is 887 micromhos per centimeter (μmhos/cm) for CM7, and 935 μmhos/cm for CM8, even though outflow (an indicator of freshwater flow to the estuary) is twice as high for CM8. Similarly, chloride concentrations predicted for CM7 (mass balance and EC-chloride relationship) at Antioch on the San Joaquin River are slightly lower than those for CM8.

The water quality chapter of the Draft EIS does not evaluate the alternatives against the full suite of Water Quality Objectives for Fish and Wildlife Beneficial Uses, which are found in Table 3 of the Bay Delta WQCP. The Delta outflow objective is discussed in Chapter 5 Water Supply, and a brief discussion of Delta outflow objective is in the HCP for only the CEQA Preferred Alternative 4.

Recommendations: *Describe mitigation measures that would prevent the proposed project from resulting in increased exceedances of water quality objectives in the already-degraded Delta. These measures may include reducing exports to provide more outflow and mitigate salinity intrusion.*

Explain the differences in the predictions among CM1 alternatives, including why twice as much outflow would result in higher salinity concentrations for Alternative 8 relative to Alternative 7. Disclose the confidence intervals for the mass-balance and EC-chloride relationship approaches for predicting future concentrations of EC and chloride.

Evaluate all CM1 alternatives with respect to all water quality standards listed in Tables 1-3 of the Bay-Delta WQCP, and indicate whether each standard would be met under each alternative.

2. **Mitigation Effectiveness**
Appendix 8H "Electrical Conductivity" states that, although the modeling results show exceedences of water quality D-1641 standards, the project proponents "intend" to operate the State Water Project and Central Valley Project facilities by fine tuning reservoir storage and exports in real time to meet the standards (p. 8H-1). The water quality objectives that would be met in this manner are not specified, nor is an estimate provided of the impact of this measure on water supply. Furthermore, the Draft EIS includes the caveat that "if sufficient operational flexibility to offset chloride increases is not feasible under Alternative 4 operations, achieving chloride reduction pursuant to this mitigation measure would not be feasible under this Alternative" (p.8-430). A similar caveat is stated regarding bromide (p. 8-422). These statements suggest that the water supply exports that define the Alternative 4 operational scenario would be given higher priority than meeting water quality standards, thus rendering that scenario potentially inconsistent with the protection of beneficial uses.

Recommendations: *Clearly identify the water quality objectives that the proponents intend to meet by fine-tuning reservoir storage and exports in real time, and clearly state this intention as an enforceable commitment. Reconcile the conflicting caveats regarding operational flexibility with this commitment.*

Provide an estimate of the amount of water that would be needed to meet water quality standards during periods when the modeling predicts exceedances, and describe how the use of water for this purpose would impact water diversions for upstream and downstream users. Include a comparison against drought years.

Provide historical data to illustrate how D-1641 standards have been met in the past, including the number of times that DWR has submitted Temporary Urgency Change Petitions with the State Water Board requesting modification of requirements of D-1641 because of drought conditions.

3. Mitigation Relationship to Water Quality Standards
EPA understands that the modeling for the water quality analysis was based on an assumption that the Emmaton EC water quality standard compliance point would be moved four miles upstream to Three Mile Slough, as DWR is anticipated to request. We also understand that DWR will request that the State Water Resources Control Board include this compliance point change as part of the Phase II update to the Bay Delta WQCP. The State Board will review this request, as will the EPA. We are concerned that the intended mitigation for the water quality violations at Emmaton relies on a change in the compliance point. We consider the movement of the compliance point to Three Mile Slough a relaxation of the EC standard because it would potentially permit four miles of additional salinity intrusion into the upper estuary, which could have negative impacts on multiple beneficial uses.

Recommendations: *Explain the technical, scientific, and policy reasons for using Three Mile Slough in DSM2 modeling for assessing EC compliance at Emmaton. Describe how EC was estimated at Emmaton under the No Action Alternative and for Existing Conditions if it was not directly estimated using DSM2; and interpret the comparison of EC at Three Mile Slough in CM1 operational scenarios to EC at Emmaton.*

Identify all of the water quality standards, including EC at Emmaton, which the BDCP assumes will be modified. Disclose the process for obtaining a modification of a water quality standard.

4. Impacts of Changes to the Salinity Gradient (X2)

The salinity gradient, approximated by X2[1], has an inverse relationship with many diverse bay and estuarine fishes, including the threatened and endangered species that are the conservation targets of the BDCP. As X2 decreases (i.e., moves out to sea) habitat conditions for some species improve and relative abundance increases[2]. Because the location of X2 is closely tied to freshwater flow through the Delta, the proposed project would have a strong influence on this parameter, yet the Draft EIS does not analyze each alternative's impacts on aquatic life in the context of this relationship.

Examination of the predicted changes in monthly average X2 for each CM1 operational scenario, A through G, would help determine how the quantity and quality of estuarine habitats and relative fish abundance would change under those scenarios for multiple fish species. It would also be useful to estimate the range of monthly average X2 values (and/or monthly Delta outflow) for each alternative and compare it to the pattern of freshwater flows and salinity gradients that characterized a reference time period when resident and migratory fish populations were in comparatively better condition. The operational scenarios that more closely mimic the reference period freshwater flow and salinity gradient pattern could be expected to produce aquatic conditions and habitats that benefit native and migratory fishes and support important food web processes at all ecosystem levels.

Freshwater flow may be one of the best tools available in the short term to improve fish populations and protect aquatic life beneficial uses prior to the completion of planned restoration projects, given its widely cited importance to ecosystem recovery. Relative fish abundance responses to freshwater flow can be estimated using regression equations provided in peer reviewed literature and government reports.[3] The equations do not directly include the effects of tidal marsh and floodplain restoration on fish populations; therefore, in their current form, they would be most useful for evaluating the impacts of flow variations prior to the completion of restoration projects. We anticipate that the ability to measure the benefits of restoration projects will improve after the projects are started and measurements and monitoring data become available.

The Draft EIS does not evaluate potential downstream effects of CM1 alternatives on San Francisco Bay fish populations. The description of impacts to San Francisco Bay from Delta Outflow changes (p. 11-132) stops at Suisun Bay even though outflow affects relative abundance of San Francisco Bay fishes such as Bay shrimp, starry flounder, and Pacific Herring. Some of these populations may be negatively affected by reduced outflows associated with CM1 alternatives, and the effect of restoration CMs (2-12) on these fish populations may or may not be beneficial.

Recommendations*: Describe the estuarine salinity gradient and how it defines important aquatic habitats, including marine, low salinity zones, and migratory corridors for target fishes. Describe its relevance to important aquatic life communities, including phytoplankton and zooplankton.*

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[1] X2 refers to the distance from the Golden Gate up the axis of the estuary to the point where daily average salinity is 2 parts per thousand at 1 meter off the bottom (Jassby et. al. 1995).

[2] Jassby AD, Kimmerer WJ, Monismith SG, Armor C, Cloern JE, Powell TM, Schubel JR, Vendlinski TJ. 1995. Isohaline position as a habitat indicator for estuarine applications. Ecological Applications 5(1): 272-289;
Kimmerer, W. J. 2002. Effects of freshwater flow on abundance of estuarine organisms: Physical effects or trophic linkages? Marine Ecology Progress Series 243:39-55;
Kimmerer WJ, Gross ES, MacWilliams ML. 2009. Is the response of estuarine nekton to freshwater flow in the San Francisco Estuary explained by variation in habitat volume? Estuaries and Coasts 32: 375-389.

[3] United States Fish and Wildlife Service, September 27, 2005, Recommended Streamflow Schedules To Meet the AFRP Doubling Goal in the San Joaquin River Basin (FWS 2005), pp. 27 *available at:*
http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/docs/sjrf_spprtinfo/afrp_2005.pdf;
Jassby AD, Kimmerer WJ, Monismith SG, Armor C, Cloern JE, Powell TM, Schubel JR, Vendlinski TJ. 1995. Isohaline position as a habitat indicator for estuarine applications. Ecological Applications 5(1): 272-289;
Kimmerer, W. J. 2002. Effects of freshwater flow on abundance of estuarine organisms: Physical effects or trophic linkages? Marine Ecology Progress Series 243:39-55;
Kimmerer WJ, Gross ES, MacWilliams ML. 2009. Is the response of estuarine nekton to freshwater flow in the San Francisco Estuary explained by variation in habitat volume? Estuaries and Coasts 32: 375-389.

Describe the Delta outflow objective in the Water Quality Chapter, including a description of the "X2" concept, recognizing that the "X2" concept provides the foundation for the Delta outflow objective and is the basis for protecting springtime estuarine habitat for resident and migratory fishes, which are the targets of the BDCP.

Include a year-round salinity gradient and/or Delta outflow analysis for each CM1 alternative. This can be accomplished using information already generated for the BDCP EIS.[4] Compare the results to a defined and supported reference period to determine how closely each scenario may mimic the salinity gradient and/or monthly outflow pattern. Alternatively, use three-dimensional modeling that maps the salinity gradient within the estuary on a monthly time step for all CM1 alternatives. This would make it possible to estimate the size and location of salinity zones, such as the low salinity zone, under different operational scenarios; however, it is not clear if this approach could be easily compared to a reference period using the same modeling tools.

Include at least one-dimensional salinity gradient and Delta outflow analyses for the fish species evaluated in Chapter 11. Define and support an agreed upon relative reference period for the analyses.

Use the referenced flow-abundance tools to predict a range of potential fish abundance changes under each operational scenario for CM1. The Kimmerer 2002 relationships should be used to evaluate potential downstream impacts to Bay fish populations. Provide the results of these analyses and explain that they do not include benefits of habitat restoration or entrainment reductions from minimizing use of south Delta pumping facilities when they cause the most harm for salmonids.[5]

C. Potential Increases in Methylmercury Formation and Transport

EPA agrees that restoring wetlands and floodplains in and near the Delta is an essential component of reviving the Estuary's health; however, nearly all the locations targeted for habitat restoration in the Delta have been, or are at risk of being, contaminated with mercury from historical mining sources and ongoing air deposition from industry. Sport fish in the Delta are already burdened with higher concentrations of mercury than anywhere else in the State,[6] and the presence of this powerful neurotoxin in the food web poses a threat to public health and the ecosystem as a whole. For this reason, health advisories have been issued for the Delta and several upstream rivers.

The BDCP relies heavily on proposed restoration in Yolo Bypass to mitigate for the adverse impacts of the CM1 alternatives on fish populations, noting that the Bypass is one of the places in the Delta that shows the most potential for providing floodplain benefits for fish, including salmon (BDCP p. 2-80). The Draft EIS, however, says that the Yolo Bypass may contribute up to 40% of the total methylmercury production in the entire Sacramento watershed (p. 25-63). The State Water Board has also observed that, when the Yolo Bypass is flooded, it becomes the dominant source of methylmercury to the Delta, and that restoration activities could exacerbate the existing mercury problem.[7] While EPA strongly supports restoration of aquatic habitat in the Delta, caution must be exercised to ensure that it

[4] Information needed to support salinity gradient and Delta outflow analyses appears to have been developed by completed modeling efforts for BDCP. The salinity gradient and low salinity zone are discussed in the HCP; X2 and Delta outflow are CALSIM outputs; a 3-dimensional model (UnTRIM) was used in Appendix 5A (Part D, Attachment 3 "Evaluation of Sea Level Rise Effects using UNTRIM San Francisco Bay-Delta Model") to predict salinity gradient changes in climate change scenarios; and a spring Delta outflow comparison was provided for the longfin smelt analysis in the Draft EIS. The longfin smelt analysis in Chapter 11 includes a comparison of average monthly spring Delta outflow between CEQA and NEPA baselines and the H1 – H4 operational scenarios.

[5] For more information, see EPA's comments to the State Water Resources Control Board regarding the State's effort to improve aquatic life beneficial use protection by modifying and/or adopting new water quality standards for flow in the Delta. See *l*etter from US EPA to SWRCB, December 11, 2012, available at http://www2.epa.gov/sites/production/files/documents/sfdelta-decpost-workshopltr-dec2012.pdf; EPA presentation to SWRCB available at http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/docs/wrkshp2/erinforesman.pdf

[6] SWAMP- Surface Water Ambient Monitoring Program http://www.waterboards.ca.gov/water_issues/programs/swamp/rivers_study.shtml

[7] P. 29 Periodic Review of the 2006 Water Quality Control Plan, State Water Resource Control Board http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/periodic_review/docs/periodicreview2009.pdf

does not result in unintended consequences that adversely affect water quality. Minimizing the formation and mobilization of methylmercury in wetlands is critical. Given the already high levels of mercury in the system, restoration in certain locations should be avoided if methylmercury production cannot otherwise be reduced or mitigated. For this reason, the BDCP's restoration acreage goals may not be attainable.

The DEIS underestimates the potential impacts of methylmercury on covered species and public health. Quantification of the methylmercury contributions from the proposed restoration were not provided in the document (this is acknowledged on p. 8-260), and the methylmercury NEPA Effects determinations rely on the success of unproven mitigation methods (CM12) that are currently under development to minimize formation and transport of methylmercury from Yolo Bypass, Cache Slough Complex, and the Cosumnes River Restoration Opportunity Areas (p.3-154). In the AQUA-8 "Effects of Contaminants Associated with Restoration Measures" evaluation of the impact of methylmercury, selenium, and other contaminants on delta smelt, the analysis of Alternative 1A concludes that methylmercury impacts to Delta smelt and winter-run Chinook salmon are "uncertain" (p. 11-277, 11-343). The analysis for Alternative 1A (and subsequent alternatives)[8] states that restoration actions (CM2, CM4–CM7, and CM10) may increase production, mobilization, and bioavailability of methylmercury in the aquatic system, but that many effects are unknown at this time.

Research studies in the Yolo Bypass that were conducted by the US Geological Survey found methylmercury production values in Yolo Bypass managed wetlands and agricultural lands to be "among the highest ever recorded in wetlands."[9] The Yolo Bypass mercury bioaccumulation study[10] reported that all caged and wild fishes sampled had methylmercury fish tissue concentrations greater than the small fish tissue objective in the Delta Methylmercury TMDL (0.03 micrograms per kilogram (µg/kg) wet weight).[11] In addition, 59% of wild fishes and 82% of caged fishes had methylmercury concentrations greater than 0.20 µg/g wet weight, which is a threshold above which fish health is impaired.[12] Finally, 52% of caged fish and 26% of wild fish had fish tissue concentrations greater than observed thresholds that reduce bird reproduction[13] and greater than the large fish tissue objective (intended to protect human health and wildlife consumers). These results suggest that increasing production, transport, and bioavailability of methylmercury through restoration actions could result in adverse effects to human health and the environment.

The Environmental Justice Chapter of the Draft EIS provides conflicting information and conclusions regarding whether or not the BDCP alternatives would create conditions conducive to increased bioaccumulation of mercury in Delta fish species, and whether such bioaccumulation would be cumulatively significant for increasing the body burden (pp. 28-22, 25, 103) in fish. The USGS Yolo

[8] Analyses for subsequent alternatives refer back to the analysis for Alternative 1A.

[9] Alpers, C.N., Fleck, J.A., Marvin-DiPasquale, M., Stricker, C.A., Stephenson, M., and Taylor, H.E., Mercury cycling in agricultural and managed wetlands, Yolo Bypass, California: Spatial and seasonal variations in water quality: Science of The Total Environment, Volume 484, 15 June 2014, Pages 276–287 http://dx.doi.org/10.1016/j.scitotenv.2013.10.096.

[10] Ackerman, J. "Agricultural Wetlands as Potential Hotspots for mercury bioaccumulation: experimental evidence using caged fish" Environmental Science and Technology 2010, 44, 1451-1457.

[11] The Delta Mercury and Methylmercury TMDL contains two fish tissue objectives that target specific beneficial uses. The average methylmercury concentrations shall not exceed 0.08 and 0.24 mg methylmercury/kg, wet weight, in muscle tissue of trophic level 3 and 4 fish, respectively (150-500 mm total length). These objectives are protective of (a) people eating 32 g/day (eight ounces, uncooked fish per week) of commonly eaten, legal size fish, and (b) all wildlife species that eat large fish. Small fish (less than 50 mm in length) – 0.03 mg methylmercury/ kg, wet weight, in muscle. The average methylmercury concentrations shall not exceed 0.03 mg methylmercury/kg, wet weight, in whole fish less than 50 mm in length. Large fish (150 – 500 mm total length) – 0.08 and 0.24 mg methylmercury/ kg, wet weight, in muscle. These objectives target protection of sensitive wildlife that eat fish. http://www.swrcb.ca.gov/centralvalley/board_decisions/adopted_orders/resolutions/r5-2010-0043_res.pdf.

[12] Frayer, W. E.; Peters, D. D.; Pywell, H. R. Wetlands of the California Central Valley status and Trends: 1939 to mid-1980's; U.S. Department of the Interior, Fish and Wildlife Service: Washington, DC, 1989.

[13] Albers, P. H.; Koterba, M. T.; Rossmann, R.; Link, W. A.; French, J. B.; Bennett, R. S.; Bauer, W. C. Effects of methylmercury on reproduction in American kestrels. Environ. Toxicol.Chem.2007, 26, 1856–1866; Burgess, N. M.; Meyer, M. W. Methylmercury exposure associated with reduced productivity in common loons. Ecotoxicology 2008, 17, 83–91, as cited in Ackerman, J. "Agricultural Wetlands as Potential Hotspots for mercury bioaccumulation: experimental evidence using caged fish" Environmental Science and Technology 2010, 44, 1451-1457.

Bypass bioaccumulation study referenced above showed that the majority of wild and caged fishes had methylmercury tissue levels above the public health threshold for trophic level 3 fish and very close to the public health threshold for trophic level 4 (large) fish. Although the Delta is posted with fish advisories, people who rely on fishing for subsistence may consume more than the advisory recommends. Although the Draft EIS acknowledges that "restoration actions are likely to result in increased production, mobilization, and bioavailability of methylmercury in the aquatic system" (p. 25-64), it concludes that there would be no adverse effects on public health to any populations (p. 25-64, p. 28-22). This conclusion is inconsistent with the potential for increased methylmercury production, bioaccumulation, and effects to Environmental Justice communities, and the proposed mitigation actions described do not address the potential for significant negative effects to human health.

Recommendations: *Acknowledge that particular areas may not be suitable for restoration or that the acreages of proposed restoration may need to be reduced if such areas prove to be large contributors of methylmercury to the Delta ecosystem.*

Summarize recent research and current literature relevant to the potential for methylmercury impairment under existing conditions and future conditions; the potential impacts on covered fishes that use the Yolo Bypass; and the potential for bioaccumulation impacts to higher order species and human health.

Describe the existing methods that show potential for reducing formation and transport of methylmercury, and the CMs to which they could be applied. Further describe the range of potential reductions that could be expected from CM12 methods for minimizing methylmercury formation and transport.

Reconcile the Draft EIS's conflicting conclusions regarding the likely impact of the BDCP alternatives on the conditions conducive to bioaccumulation of methylmercury, and provide the basis for these conclusions.

Describe and commit to water column and fish and invertebrate tissue monitoring for mercury and methylmercury to support adaptive management actions. Include a commitment to ensure that adequate warning signs are posted in appropriate languages regarding the risks of consuming fish caught in the Delta, and provide further outreach to minority populations about these risks. Such outreach should include meaningful involvement by the affected populations.

D. Selenium

Soils on the west side of the San Joaquin Valley are high in selenium. As a result, it is present in agricultural drainage and enters the Delta in the San Joaquin River at Vernalis. When mobilized in the environment and transformed to organic, bioavailable forms, selenium is highly bioaccumulative and can be toxic to organisms at very low levels of chronic exposure. The BDCP proposes to bring additional reliable water to the west side of the San Joaquin Valley. This would result in a greater volume of water and greater loads of selenium being discharged to the San Joaquin River. Although available data show that the maximum selenium concentration at Vernalis is not exceeding the current water quality objective of 5 micrograms per liter (µg/L)[14] (p. 8-96), the operations of the proposed project would contribute significantly more selenium-laden San Joaquin River water to the Delta (p. 8-226). In addition, EPA is in the process of updating its national recommended chronic aquatic life criterion for selenium in freshwater to reflect the latest scientific information, which indicates that toxicity to aquatic life is driven by dietary exposures. As of this writing, a peer review draft of the

[14] 4-day average for above normal and wet year types and a monthly mean for dry and below normal water year types.

updated criterion is undergoing public review, with comments due to EPA in July 2014. Following consideration of comments received, the draft criterion will be revised, as appropriate, and released as a draft criterion for public review.

EPA is concerned that the potential effects of selenium on covered species, especially green sturgeon, are underestimated in the Draft EIS. The analysis discusses increased residence time of selenium in Suisun Bay and concludes that the impacts of the proposed restoration measures on green sturgeon are "not adverse"; but does not discuss the south Delta, which would receive increased loads of selenium under all CM1 alternatives (p. 11-526). The increased loads, combined with increased residence time, could lead to greater selenium absorption in clam tissue, which is a primary food item of sturgeon (p. 11-257). Adverse effects of elevated selenium on early life stages of green sturgeon have been documented[15].

Likewise, impacts of increased selenium loads to salmonids are not adequately addressed in the Draft EIS. Although salmonids do not eat clams, they are sensitive in all their life stages (figure 12 in Presser, Luoma 2010).[16] One objective of the San Joaquin River Restoration Project (SJRRP) is to manage the river to restore salmon migration. The increased drainage of selenium-enriched water from the West side of the San Joaquin Valley that would likely result from the BDCP could compromise this effort.

Recommendations: *To mitigate for the project's impacts to selenium levels in the estuary as a result of the BDCP operations, consider reviving and funding the Bureau of Reclamation's Land Retirement Program[17] to remove from cultivation and irrigation large areas of selenium laden lands on the West side of the San Joaquin Valley. This would save irrigation water, reduce discharges of selenium into the San Joaquin River basin, and advance attainment of selenium reduction targets[18] set by EPA and the Central Valley Regional Water Quality Control Board. Evaluate the extent to which restoration of these "retired" lands to the native plant community could also contribute to the recovery of threatened and endangered plants and animals listed by FWS. Consider analyzing the cost/benefit of implementing treatment technologies vs. land retirement. Although cost/benefit analyses are not required under NEPA, such an analysis may be useful to decision makers and the public in this case.*

Reanalyze the proposal to develop wetlands as part of the conservation plan, taking into account the increased amount of agricultural drainage water from selenium-enriched lands that would enter these areas in the Delta as a result of BDCP operations, and the potential for selenium build-up and availability.

Discuss hydrodynamics and increased residence time of selenium in the San Joaquin River in the southern Delta and its potential impact on clam uptake of selenium, bioaccumulation in sturgeon, and the potential for population effects.

Reference and summarize the available literature regarding the impacts of selenium on sturgeon, especially with respect to early life stages, and consider such impacts in the analysis of increased selenium loading.

The evaluation of the Alternatives should consider the objectives of ongoing or proposed projects and programs that are intended to improve Bay Delta water quality and fish and aquatic resources. Disclose

[15] Linares, J., Linville, R. Eenennaam, JV, Doroshov, S. 2004 Selenium effects on health and reproduction of white sturgeon in the Sacramento-San Joaquin estuary. Final Report for Project No. ERP-02-P35.
[16] Presser TS and Luoma SN 2010 Ecosystem-Scale Selenium Modeling in Support of Fish and Wildlife Criteria Development for the San Francisco Bay-Delta Estuary, California USGS Administrative Report.
[17] http://www.usbr.gov/mp/cvpia/3408h/index.html
[18] http://www.gpo.gov/fdsys/pkg/FR-2000-05-18/html/00-11106.htm

potential conflicts with such projects or programs, as well as ways in which such conflicts could be avoided or minimized. In particular, the potential for competing management objectives between the BDCP and the SJRRP should be comprehensively analyzed and described.

E. Additional Water Quality Impacts

The conclusion that there would be no impact to dissolved oxygen concentrations in reservoirs (p. 8-192, lines 6-15) is unsupported given that three major reservoirs are predicted to experience a 10% increase in dead pool under the No Action Alternative.

Recommendation: *Describe how predicted dead pool conditions in reservoirs may impact dissolved oxygen concentrations and other contaminant concentrations that may increase in these extreme conditions, and revise the impact conclusions, as appropriate.*

It is not clear whether residence time was considered in the impact assessment of water quality contaminants such as pesticides and metals. It appears that southern Delta residence times would increase due to increased use of the north Delta pumps (and decreased use of south Delta pumps), limiting freshwater inputs to, and movement of water in, the south Delta. These conditions could increase residence time of water moving through the southern Delta, which would increase aquatic life exposure to contaminants such as pesticides and selenium.

Recommendation: *Explicitly state whether or not residence time was included in assessments of contaminant impacts on aquatic life and other beneficial uses in the water quality analysis. If residence time was not considered, explain why it was not included and how increasing residence time could increase negative effects of contaminants as a result of CM1 operations.*

II. Fish and Aquatic Resources

A. Aquatic Resources Beneficial Uses

Data and other information provided in the Draft EIS indicate that that all CM1 alternatives may contribute to declining populations of Delta smelt, Longfin smelt, green sturgeon, and winter-run, spring-run, fall-run and late-fall run Chinook salmon. Impact analyses in Chapter 11 show that entrainment, rearing, and migration conditions for these species are estimated, for many of the action alternatives, to be similar to, or worse than, existing conditions and sometimes worse than the future no action condition. Some of the NEPA effects that are described as "not determined" for some alternatives are very similar to effects that are described as "adverse" for other alternatives. Data regarding the impacts on fish is provided in various tables, and the summary statements made in the text do not always accurately reflect the information in those tables.

1. Longfin Smelt Abundance

Long-term and recent sharp declines in fish abundance have been cited by the lead federal agencies, their partners, and EPA as evidence of collapse in the Bay Delta ecosystem. Longfin smelt relative abundance is estimated to decline for all but one of the CM1 alternatives in most water year types (and in the average of all water year types) when compared to *Existing Conditions*.[19] Alternative 8 is the only alternative that has a predicted relative abundance increase for Longfin smelt relative to *Existing Conditions*. In comparison to the *No Action* Alternative, four CM1 alternatives are predicted to result in declines in the Longfin smelt abundance index, while five CM1 alternatives are predicted to result in positive changes to that index. Despite these predictions, the Draft EIS concludes that the

[19] Table 11-1A-8 page 11-297 "Estimated differences between scenarios for longfin smelt relative abundance in FMWT or Bay Otter Trawl,", Table 11-2A-7 page 11-764, Table 11-3-7 page 11-1097, Table 11-4-8 page 11-1308; Table 11-5-7 page 11-1742; Table 11-6-8 page 11-1951; Table 11-7-7 page 11-2227, Table 11-8-8 page 11-2492; Table 11-9-8 page 11-2768.

impact on Longfin smelt abundance would be "not determined" for all CM1 alternatives for the NEPA effects determination. This conclusion disregards the predicted differences among the alternatives in comparison to the *No Action Alternative*, and the predominantly negative impacts in comparison to *Existing Conditions*.

2. **Entrainment of Juvenile Delta Smelt**
The summary table on page 11-55 of the Draft EIS states that Alternative 4's flow-related effects on fish would lead to "beneficial impacts" with respect to entrainment of Delta smelt. While the prediction for Alternative 4 shows somewhat less entrainment in comparison to the No Action Alternative, the predicted difference is much smaller for juveniles than for adults, and Alternatives 1, 2, 7, and 8 are predicted to result in substantially less entrainment at all life stages. Compared to Existing Conditions, Alternative 4 is predicted to result in *increased* entrainment of Delta smelt, especially juveniles. It is unclear how increases in juvenile entrainment would result in overall beneficial impacts. Entrainment estimates provided in the Draft EIS show reductions in adult entrainment, but increases in juvenile entrainment for all Alternatives except Alternatives 7 and 8, compared to Existing Conditions, and for Alternatives 3 and 5, compared to the No Action Alternative. The discussion in the text provides the caveat that "entrainment is expected to remain at or below the levels currently experienced by fish… there are very few instances where there would be increases, but these are substantially offset by decreases during other periods" (p.11-53).The analysis does not describe the relative importance of reducing entrainment of each life stage (adult and juvenile) to the overall population. No comparison among alternatives is provided, nor does the Draft EIS explain why some alternatives, such as Alternatives 7 and 8, show much larger reductions than other alternatives in both juvenile and adult entrainment.

3. **Impacts on Delta Smelt Rearing Conditions**
The Draft EIS forecasts changes to rearing conditions for Delta smelt by estimating the change in available fall abiotic habitat with and without estimated habitat restoration benefits relative to the two baselines: Existing Conditions and No Action Alternative. CM1 alternatives with "Fall X2" operational criteria are predicted to increase fall rearing habitat relative to the No Action Alternative. These include CM1 Alternatives 2, 4 H4, and 5-9. Alternatives 6 (isolated facility, eliminates south Delta exports) and 7 (enhanced flows) show the highest predicted increases in fall rearing habitat. The absolute values of fall rearing habitat or significance thresholds are not provided.

Recommendations: *Modify operational scenarios for CM1 alternatives to develop at least one alternative that would have more certain and beneficial effects on covered fish populations during all life stages.*

Present the predicted impacts to each of the covered fish species and impact categories (entrainment, spawning, rearing, migration), for all the alternatives and baselines in comparative form, sharply defining the issues and providing a clear basis for choice among options by the decision-makers and the public (40 CFR 1502.14).

Provide absolute value estimates and proportional changes, in addition to relative changes from baselines, for predictions under each CM1Alternative.

Describe the scientific basis of, and uncertainty associated with, any assumptions made in the analysis, including in the development of the No Action Alternative. This may include, for example, data regarding current entrainment levels of all covered fish species at all life stages in all water year types.

B. NEPA Effects Determinations

The NEPA Effects Determinations provided in the Draft EIS are not always consistent with the impacts described. We list a few examples below.

- **Alternative 1 AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt:** The description of impacts reports a 22% loss of rearing habitat (p. 11-265), which suggests that the impact should be considered adverse if proposed habitat restoration does not produce anticipated benefits. Instead, Table 11-1A-SUM2 (page 11-16) lists the NEPA Effects Determination as "Not Determined." The NEPA Effects discussion on page 11-265 does not explicitly state that the NEPA Conclusion is "not determined."
  Alternative 1 AQUA-21 Effects of Water Operations on Entrainment of Longfin Smelt: The description of impacts shows that entrainment is estimated to increase for juvenile Longfin smelt in dry (14%), below normal (46%), and above normal (33%) water year types (Table 11-1A-6), and the ***Summary*** text on page 11-295 states, "It is concluded that these changes in Longfin smelt entrainment would be adverse under Alternative 1A." The subsequent ***NEPA Effects*** statement comes to a different conclusion, "The overall effect of the Alternative 1A operations scenario would not be adverse to Longfin smelt." Table 11-1A-SUM2 also lists the NEPA conclusion for entrainment of Longfin smelt as "not adverse."
- **Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing Habitat for Longfin Smelt.** The NEPA Effects discussion predicts reductions of 8 to 10 percent in relative abundance of Longfin smelt for Alternative 1A, suggesting an adverse impact on this species from Alternative 1A. No NEPA conclusion is explicitly stated in this section (p. 11-295); however, Table 11-1A- SUM2 (page 11-16) lists the NEPA conclusion as "not determined."

Furthermore, throughout the document, different NEPA Effects Determinations are provided for similar impact descriptions. For example, in the discussion of "Effects of Water Operations on Migration Conditions for Winter-Run Chinook Salmon", the Draft EIS concludes that Alternatives 1 and 8 would have "adverse" NEPA Effects and Alternatives 7 and 4 would have "not determined" NEPA Effects, even though the estimated NEPA effects are quantitatively similar for the multiple metrics evaluated. It is not apparent how the lead agencies decided that one impact was beneficial and another adverse.

Recommendations: *Describe the decision making process and decision rules used to make NEPA Effects Determinations from the analytical information presented for each impact category. Define the NEPA Effects Determinations and provide thresholds -- quantitative when possible -- for each category so that it is clear why some estimated impacts result in one NEPA Effects Determination over another. Explain whether all metrics are considered equal in the analysis or some are weighted. If negative impacts in one metric category translate into an adverse conclusion, regardless of the other metrics, this should be disclosed. Include summary tables for each impact category so that the reader can see the metrics and their results and how they compare among alternatives.*

Compare the NEPA Effects Determinations with the narrative text describing the metrics and NEPA Effects among all alternatives for each impact category (e.g., AQUA-42 above) to ensure that decision rules and methods are used consistently.

III. Analytical and Presentational Issues

A. Defining the Project Proposal

The proposed project evaluated in the Draft EIS is not fully defined. EPA is aware that interagency discussions with the project proponents regarding key aspects of the proposed project are ongoing. Many of the undefined aspects of the BDCP are fundamental to the potential environmental impacts of

the proposal. For example, it is EPA's understanding that potential agreement, in advance, to a certain range of exports is under consideration in the HCP discussions. While an Implementation Agreement has been released for public comment, it is incomplete and is still being discussed by the involved parties. The Implementation Agreement's financing and decision making elements are important for public disclosure because they affect the likely implementation and success of mitigation and environmentally beneficial activities, yet these effects are not described for public review in the DEIS.

In addition, given the large scale nature of the construction activities associated with the BDCP, "minor" changes in proposed project design or operation can make a significant difference in the potential environmental impacts.

Recommendation: *Fully describe the proposed project and reasonable alternatives, including information that is integral to decisions that are being made about the proposed project design and operations.*

The Draft EIS explains that the adaptive management program is a work in progress (p. 3D-9, BDCP p. 3.4-32). The specific approach for an adaptive management program and its effect on environmental consequences is a fundamental issue that should be addressed during the NEPA process. Given that species recovery depends largely on the success of the adaptive management program, it is essential that a more fully formulated adaptive management program be described in the EIS.

Recommendation: *Describe the adaptive management program in detail, including clear objectives, explicit thresholds, alternative hypotheses, and designated responsible parties. In addition, explain any limitations imposed on the adaptive management program by the Implementation Agreement, and explain how those limitations affect the integrity of the adaptive management program.*

B. Alternatives Analysis

The Draft EIS states that alternatives in the document are "evaluated at an equal level of detail, as required by NEPA" (p. 3-5); however, the lead federal agencies' Progress Assessments indicate that the operational components of the alternatives were subjected to different levels of analysis. For example, iterative modeling runs were conducted for Operational Scenario H (solely associated with the CEQA Preferred Alternative 4) that were not run for other Operational Scenarios.

The Draft EIS defines the Alternatives in terms of the design and capacity of the proposed conveyance structure. Each alternative is then paired with a particular operational scenario. EPA agreed with this organizational construct early in the BDCP process, expecting to see a range of alternatives that could present the environmental and water supply tradeoffs being considered. Instead, the DEIS focuses primarily on Alternative 4. It appears that the environmental impacts of certain other alternatives would be reduced if those alternatives were matched with more optimal operational criteria (for example, Alternative 5 with Operational Scenario F); however, the DEIS does not attempt to optimize the other alternatives for environmental and water supply benefits. Other reasonable alternatives could be developed by incorporating a suite of measures, including water conservation, levee maintenance, and decreased reliance on the Delta.[20] Such alternatives would be consistent with the purpose and need for the project, as well as with the California Bay-Delta Memorandum of Understanding among federal agencies[21] and the Delta Reform Act of 2009.

[20] The "Portfolio Approach" developed by a diverse set of stakeholders is one attempt to place Delta water management into the larger context of facilities investments and integrated operations.

[21] http://www2.epa.gov/sites/production/files/documents/baydeltamousigned.pdf

Recommendations: *Work with State and federal partners to modify and further analyze the proposed Operational Scenarios to improve the precision and utility of the aquatic life analyses for all the operational alternatives.*

If differences in the level of analysis remain among the Alternatives, disclose, and explain the reason for those differences.

Evaluate the environmental impacts of pairing each Alternative with more optimal operational criteria.

C. Comparison of Alternatives

The Draft EIS does not clearly present the alternatives and their respective environmental impacts in a clear and comparative manner. Because technical results are not synthesized and displayed in a comparative format, it is difficult for the reader to compare the predicted effects of CM1 alternatives.

Further compounding the difficulty is the fact that the Draft EIS uses two very different baselines (Existing Conditions and No Action), pursuant to CEQA and NEPA regulations, and neither baseline is clearly defined. The assumptions that inform the baseline descriptions are spread throughout the document (Chapter 4, Appendix 4D, Appendix 5A, and Appendix 3A). Although Chapter 4 attempts to summarize the baselines, the summary is confusing, and references appendices that are hundreds of pages long. The baseline assumptions form the basis for all impact assessments; therefore, their lack of clarity creates an underlying uncertainty in the document's analyses and conclusions.

The Draft EIS considers many other types of uncertainties, including those related to long-term climate change and human behavior, however, the treatment of uncertainty is confusing and exhibits a strong tendency to assume outcomes favorable to the proposed project. Uncertainties are expressed by "non-determined" NEPA conclusions, but they are not explicitly detailed in the body of the Draft EIS. EPA has repeatedly raised concerns about the treatment of uncertainty in the Draft EIS, and the Delta Independent Science Board and an independent panel commissioned by the Delta Science Program recently expressed similar critiques.[22] Notably, the Panel concluded that the Effects Analysis of the BDCP (as incorporated by reference into the EIS) is "fragmented in its presentation, inconsistent with its technical appendices, and… inadequately conveys the fully integrated assessment that is needed to draw conclusions on the Plan due to incomplete information."

Recommendations: *Include, in the body of the document, summary tables comparing the effects of all CM1 alternatives and the No Action Alternative to the applicable water quality standards and other relevant environmental impact indicators, and compare and contrast the alternatives with respect to one another in the text. This discussion should inform potential mitigation strategies by identifying which alternatives would need more or less mitigation to comply with environmental objectives.*
Clearly explain the underlying assumptions inherent in the baselines. We suggest that this be presented in Chapter 4.

Explicitly acknowledge uncertainties encountered in the analyses, explain what has been or could be done to eliminate or reduce those uncertainties, and disclose any assumptions made in the face of uncertainties that could not be eliminated.

[22] Delta Independent Science Board Review: http://deltacouncil.ca.gov/sites/default/files/documents/files/Cover-letter-v.4.pdf
Independent Science Panel Review: http://deltacouncil.ca.gov/sites/default/files/documents/files/Delta-Science-Independent-Review-Panel-Report-PHASE-3-FINAL-SUBMISSION-03132014_0.pdf

D. Scope of Impact Analysis

The scope of analysis in the Draft EIS does not fully consider upstream and downstream impacts of the proposed actions in the Delta. As evidenced by the intergovernmental response to California's ongoing drought, the state and federal water projects are functionally and physically interconnected. For example, actions that Central Valley Project (CVP) operators take from the Trinity River have implications for South of Delta CVP and SWP deliveries, and operational changes in the Delta require upstream adjustments in project operations. Based on EPA's ongoing discussions with the federal lead agencies, we understand that the U.S. Bureau of Reclamation is continuing to evaluate its broad operational response to the proposed changes in the Delta, for both near term and longer term operations. Upstream operational changes caused by BDCP implementation could have significant environmental and water supply impacts in the upstream areas, and these impacts must be disclosed in the DEIS. Similarly, the BDCP activities are expected to have impacts on downstream aquatic resources in San Pablo and San Francisco Bay, primarily by changing the magnitude and timing of outflow and by altering the mix of contaminant inputs from upstream (see discussion of selenium, above.)

Recommendation: *Explicitly recognize the integrated nature of the watershed and the water supply projects operating in the watershed, and analyze the upstream and downstream impacts, in particular to water supply and aquatic resources.*

E. Integrated Water Management

The BDCP effort has been ongoing since 2006. Initially, its broad goals were (a) the preparation of an HCP for continued operation of the state and federal water projects, and (b) a change in the mode of conveyance of export water through the Delta. As evidenced by the Alternatives Screening Criteria, as well as Water Supply Chapter 5 of the Draft EIS, there is now also a strong water supply *enhancement* component to the BDCP. That is, the project proponents appear to be anticipating that the CEQA Preferred Alternative 4 of the BDCP would result in the same or greater water exports (ranging from a decrease of 1% to an increase of 18%) than would be available in the absence of the BDCP (Table 5-9). Since the goals of a project drive the scope of the alternatives that must be evaluated in the NEPA process (as well as in the subsequent CWA Section 404 permitting process), EPA believes that a more robust discussion and evaluation of the water supply component of this project is warranted in the EIS.

California is moving quickly towards integrated water management, yet it is not clear how, as currently drafted, the BDCP conveyance component is consistent with this approach. Although the Draft EIS acknowledges California's progress in Demand Management in Appendix 1C, demand management is not incorporated into the project alternatives. Alternatives, such as the Portfolio Alternative, that proposed a more comprehensive and integrated approach to meeting the stated dual goals of the BDCP, were not evaluated.

Recommendations: *Explain how the proposed changes in conveyance and exports fit within the larger integrated water management plan for California. Include a more comprehensive consideration of, and response to, suggested alternatives such as the "Portfolio Alternative" and discuss the demand scenario driving the Delta export facilities. Include a consideration of the significant water conservation efforts Statewide and in the export areas.*

F. Habitat Restoration

We are concerned that the analysis assumes a 100 percent success rate for habitat restoration, which is not consistent with our experience, or supported by restoration ecology and conservation biology academic literature and scientific investigation. The potential adverse impacts of CM1 operations would be greater than projected in the DEIS in the likely event that restoration of the Bay Delta ecosystem is not 100 percent successful.

Recommendations: *Discuss restoration methods, performance metrics, and documented success rates for each habitat restoration type proposed.*

Work with the federal and state wildlife agencies to develop analytical methods to evaluate gradients of partial success for each habitat type. Re-evaluate the impacts of each Alternative (CMs2-11) in light of these gradients and the likely success rates for each habitat restoration type. Incorporate the results into final conclusions about the impacts of BDCP alternatives.

G. Aquatic Species Recovery

Although not explicitly stated in the Draft EIS, the primary premise of the BDCP appears to be the hypothesis that endangered and threatened fish populations in the San Francisco Estuary can be protected from further degradation by habitat restoration without increasing freshwater flow to the Estuary. As noted in the Executive Summary, restoration of more than 150,000 acres of habitat is proposed under most BDCP alternatives. Only moderate changes in freshwater flows (Delta outflow) to the Estuary are proposed under any of the alternatives. In particular, all sub-alternatives for CEQA Preferred Alternative 4) would result in less Delta outflow compared to the No Action Alternative (DEIS Table 5-9).

The habitat restoration-only premise is inconsistent with broad scientific agreement, reflected in EPA's Delta Action Plan[23], that existing freshwater flow conditions in the San Francisco Estuary are insufficient to protect the aquatic ecosystem and multiple fish species, and that *both increased freshwater flows and aquatic habitat restoration* are needed to restore ecosystem processes in the Bay Delta and protect native and migratory fish populations.[24]

The Draft EIS acknowledges the importance of freshwater flow to fish species abundance, but is inconsistent in describing its analyses of the benefits of habitat restoration versus increased freshwater flow. For example, page 11-202, lines 24 to 28 state that "although it is recognized that there are statistically significant correlations between freshwater flow and abundances of several fish species (e.g., Kimmerer 2002, FWS 2005), these correlations were not used in the EIR/EIS analysis to estimate fish population responses to alternatives because they do not directly include the effects of tidal marsh and floodplain restoration on fish populations." Elsewhere (e.g., p. 11-297), the document states that the Kimmerer 2002 model *was* used for the analysis. Correlations that do not include the effects of restoration were rejected for some analyses, but not for others.

Recommendation: *A consistent approach that recognizes the demonstrated significant correlations between freshwater flow and fish species abundance should be used to analyze all of the Alternatives. Describe the analytical approach and provide the rationale for, and implications of, any deviations from it.*

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[23] http://www2.epa.gov/sites/production/files/documents/actionplan.pdf

[24] This broad scientific agreement is illustrated in the following reports: (a) Public Policy Institute of California (2013) Scientist and Stakeholder Views on the Delta Ecosystem "a strong majority of scientists prioritizes habitat and flow management actions that would restore more natural processes within and upstream of the delta" (p. 2). http://www.ppic.org/content/pubs/report/R_413EHR.pdf
(b) State Water Resources Control Board (2010) Development of Flow Criteria for the Sacramento-San Joaquin Delta Ecosystem Flows Report, p.7. "Both flow improvements and habitat restoration are essential to protecting public trust resources [defined as "native and valued resident and migratory species habitats and ecosystem processes" p. 10].
(c) National Academy of Sciences Natural Resource Council Committee on Sustainable Water Management in California's Bay-Delta (2012) Report: Sustainable Water and Environmental Management in California's Bay-Delta "…sufficient reductions in outflow due to diversions would tend to reduce the abundance of these organisms ["these organisms" = 8 Bay Delta aquatic species at various trophic levels]." Page 60 and "Thus, it appears that if the goal is to sustain an ecosystem that resembles the one that appeared to be functional up to the 1986-93 drought, exports of all types will necessarily need to be limited in dry years, to some fraction of unimpaired flows that remains to be determined." Page 105
(d) California Department of Fish and Wildlife (2010) Quantifiable Biological Objectives and Flow Criteria "…current Delta water flows for environmental resources are not adequate to maintain, recover, or restore the functions and processes that support native Delta fish." Page 1 in Executive Summary

H. Project-level Decision-making

The Draft EIS indicates that it provides a *project level* analysis of the proposed changes in conveyance (CM1) and a *programmatic* analysis of other BDCP elements. The level of engineering detail provided for the tunnels is not commensurate with the level of site-specific information typically provided in an EIS for a project that would require federal permits. For example, actions that would result in impacts to aquatic resources (e.g., grading, dredging, trench and fill, boring, spoils piling, levee work, excavation, etc.) are not detailed or quantified at a project-level of detail (e.g., limited information is provided regarding acres and/or linear feet of estimated impacts to waters of the US, the volume of sediment proposed for disposal sites, or the size and length of intakes, p. 3-92; 3C-3). Where reusable tunnel material sites are estimated for the pipelines and the forebays, they are estimated only for the preferred alternative and "may" be on the order of thousands of acres (p. 3-96). We do not believe the information provided in the Draft EIS is adequate to support a full assessment of the project-level impacts and mitigation opportunities, or to determine whether the project, as proposed, would satisfy requirements for requisite authorizations and permits. Given the lack of project-level information, EPA agrees with the Corps that supplemental NEPA review will be needed before a section 404 permit or CWA section 408 "Letters of Permission" could be issued.[25]

The use of programmatic inputs to project-level analyses in the Draft EIS also substantially limited the predictive power of evaluations that were intended to provide project-level precision. For example, Section 8.4.1.7 "Constituent-Specific Considerations Used in the Assessment" states that the modeling to predict water quality effects (salinity) of CM1 operational scenarios relied on estimates of impacts from implementation of other conservation measures, specifically CM2 (Yolo Bypass Floodplain Restoration) and CM4 (tidal marsh restoration), which are evaluated in the Draft EIS at a programmatic level (p. 8-153). A representative estimate of the location and amount of tidal marsh restoration was used to predict water quality effects under each CM1 operational scenario. The programmatic nature of the CM4 input, which is based on an assumed 100 percent success rate, represents only one potential future configuration of tidal marsh restoration. The actual success rate and physical location(s) of tidal marsh restoration will have varying impacts on water quality elements such as salinity. The representative locations and amounts of CM4 and CM2 that were used for CM1 water supply modeling were not disclosed in the Draft EIS, nor has any feasibility analyses been cited that describes the availability of suitable sites in the restoration opportunity areas. The uncertainties introduced by the use of CM4 programmatic estimates raises concerns over the reliability of water quality modeling results, and whether the analysis presented in the Draft EIS is sufficient to support federal permit decisions.

Despite the substantial impact that the physical location of tidal marsh habitat restoration may have on water quality elements such as salinity, the Draft EIS does not describe how the locations for CM4 estimates were chosen or how likely it is that CM4 would result in the targeted amount of restoration (65,000 acres). A tidal marsh restoration success rate of less than 100 percent may yield very different results for predicted salinity values under each CM1 operational scenario. Typical success rates for wetland restoration have been reported to be substantially lower, e.g., on the order of 20-60 percent, and full restoration may require decades[26], yet this underlying uncertainty associated with the predicted salinity values is not characterized in the Draft EIS.

The envisioned CM-1 tunnels would require one of the largest construction projects in the nation, which would occur in the upper portion of a sensitive estuary. The proposed structure includes elements (e.g.,

[25] See Corps comments on the Draft EIS July 16, 2014 and July 29, 2014

[26] J.L. Lockwood and S.L. Pimm (1999), When Does Restoration Succeed? (Chapter 13 in Ecological Assembly Rule: Perspectives, Advances, and Retreats; and Angel Borja & Daniel M. Dauer & Michael Elliott & Charles A. Simenstad (2010) Medium- and Long-term Recovery of Estuarine and Coastal Ecosystems: Patterns, Rates and Restoration Effectiveness, Estuaries and Coasts (2010) 33:1249-1260.

intake facilities and fish screens) that have never been constructed in the Sacramento River at this scale, yet the Draft EIS provides only a qualitative analysis of construction-related water quality impacts. This is inconsistent with the intent of the Draft EIS to support project-level decision making, which necessitates project-level analysis. Assessment of construction-related impacts is a basic element of project-level analysis, yet the Draft EIS provides no quantitative estimates of the amounts of soil, sediment, and contaminants that would be discharged to water bodies during CM1 construction, nor a rationale for not including such estimates. The qualitative description of best management practices does not provide an adequate basis for a lead federal agency to write permit conditions that would be effective in minimizing the water quality impacts of constructing CM1.

Additionally, on page 8-293, in lines 35 to 38, the Draft EIS states that "Alternative 1A would result in similar potential contaminant discharges to water bodies and associated water quality effects to those discussed above for the no action alternative." It is not clear how the impacts on water quality from construction-related activities of building a 35-mile twin tunnel facility, with 5 screened on-bank intakes, would be the same as not building it.

Recommendations: *Provide quantitative information regarding project footprints and estimates of soil, sediment and contaminant discharges during construction, as well as the impacts of those discharges and measures that would mitigate those impacts.*

Provide the level of detailed information necessary to support project-level analyses and permit and authorization decision making, or specify and commit to the additional detailed work and appropriate supplemental NEPA analysis that will need to be done prior to project-level decision making.

Provide confidence intervals around predicted water quality effects of CM1 operational scenarios. Describe the methods used to identify tidal marsh habitat locations for estimating water supply effects of CM1 operational scenarios, and explain the reasons for choosing these locations. Disclose the tidal marsh habitat locations that were used to estimate water supply effects of CM1 operational scenarios. Evaluate water supply effects of CM1 scenarios using several configurations and success rates of CM4 and disclose methods and results.

Provide a summary of tidal marsh habitat success rates reported in academic literature and restoration industry reporting. Include a description of elements that drive restoration success, including location characteristics and restoration actions.

Describe the locations in Restoration Opportunity Areas that exhibit the location characteristics that optimize restoration success, would provide salinity gradient habitat benefits for pelagic native fishes and would protect municipal water supply intakes.

I. Energy Infrastructure

The Draft EIS indicates that DWR will conduct a five-to-seven year Systems Impact Study (SIS) to evaluate the electrical transmission and power needed for conveyance facilities (p. 21-22). This study is projected to be completed in time to procure the necessary power to support construction and operation of the facilities. Based on the Draft EIS, it is not clear whether the SIS could affect the conclusions summarized in the EIS, of the energy needed for the system (Table 21-11 p. 21-34) or to what extent it may influence the procurement and placement of future transmission and associated infrastructure.

Recommendations: *Provide additional details on the purpose of the SIS and how it may affect the assessment of the BDCP's energy needs as well as the procurement and placement of future transmission and associated infrastructure.*

In the absence of the SIS, disclose the assumptions made regarding electrical transmission placement and energy needs for the proposed conveyance facilities and whether the SIS could affect the analysis of environmental impacts.

Clarify, particularly with respect to impacts on terrestrial species, the level of uncertainty involved with future placement, and associated impacts, of the transmission line and related infrastructure pending the completion of the SIS.

Discuss whether the SIS would provide an opportunity to focus procurement of a guaranteed source of 100% renewable energy (e.g., contractually binding agreement) for the BDCP.

J. No Action Alternative

The No Action Alternative assumes that no BDCP actions would be undertaken, and that climate change and sea level rise would occur and water demands and diversions north and south of the Delta would increase, resulting in reduced freshwater flows into the Delta (p. 5-57). Under the No Action Alternative described in the Draft EIS, no action would be taken in response to the impacts of climate change and sea level rise on the Delta.

EPA supports the Draft EIS's recognition that climate change and sea level rise would likely result in decreased freshwater flows into and through the Delta and increased salinity intrusion; however, the assumption that, in the face of diminished overall water supply due to climate change, diversions north of the Delta would be allowed to increase seems unrealistic. Similarly, maintaining existing reservoir operations and meeting existing water supply demands is unlikely with the predicted effects of sea level rise and climate change. Comparing the CM1 alternatives to a "No Action" Alternative that assumes that no actions would be taken by *any* party to address climate change-induced reductions in overall water availability has the potential effect of exaggerating the benefits of the CM1 alternatives to the project proponents.

The Draft EIS appears to contradict itself by stating that some of the water supply delivery differences between CM1 alternatives and the No Action Alternative in the year 2060 are "*solely* attributable to sea level rise and climate change, and not to the operational scenarios themselves (emphasis added, p. 5-47, lines 20-23)." This overlooks the significant impact of the CM1 project operational scenarios, which propose exporting volumes of water approximately equal to, or greater than, those exported under existing conditions, regardless of overall water availability. In a future affected by climate change and sea level rise, with less fresh water to allocate among <u>all</u> water users, exports of such magnitude would further reduce water availability for other uses and users.

Recommendations: *Consider and incorporate into the No Action Alternative predictable actions by other parties to address the anticipated effects of increased north of Delta demands, climate change, and sea level rise on water availability. This should include consideration of any measures that would likely be taken to reduce demands both north and south of the Delta.*

Clarify that the comparisons of CM1 alternatives to the No Action Alternative isolate the effects that would be attributable to CM1, and that such effects would occur in the context of increased north of Delta demands, sea level rise, and climate change, not "in the absence of" the effects of those stressors.

K. Impacts to Wetlands

At this time, no Clean Water Act (CWA) Section 404 permit application has been submitted for discharges of dredged or fill material into waters of the United States, including wetlands, associated

with projects described in the BDCP. EPA and the Corps encourage lead agencies to proactively integrate CWA Section 404 regulatory requirements into the NEPA process to streamline environmental review by using NEPA documents for multiple permitting processes. With this in mind, EPA and the Corps met with the lead and federal state agencies multiple times over the past several years in the interest of using the BDCP EIS/EIR to inform Corps' CWA 404 regulatory decisions. Although constructive and informative, those meetings did not result in an agreement to coordinate the NEPA and CWA 404 permit reviews.

Information provided in the Draft EIS and through meetings with the lead agencies illustrate that there are substantial challenges to finding that discharges associated with Alternative CM1 are consistent with the CWA Section 404(b)(1) Guidelines. In addition, the Draft EIS acknowledges that additional analyses for NEPA may be required to support Corps CWA Section 404 permit decisions for CM1 and that additional NEPA work will be done for other conservation measures (p.1-13). The Corps also submitted comments on the Draft EIS verifying that the Draft EIS does not provide the site-specific information necessary to form the basis for a permit decision, and we agree with that comment.[27]

Recommendation: *Demonstrate that the proposed project would meet the requirements for a CWA section 404 permit.*

Wetland Extent and Jurisdiction (Section 12.3.4)
The accuracy of the CWA jurisdictional determination and estimates of impacts to jurisdictional waters need to be improved for project-level analysis. The Draft EIS is intended to provide project-level information for CM1. However, the BDCP applicants were not able conduct field delineations of wetlands and waters of the U.S. Instead the extent of wetlands and other waters in the study area was determined primarily using aerial photography interpretation in a GIS with limited (26 sites) field delineations (p. 12-146). However, the Draft EIS does not provide an estimate of GIS-based mapping accuracy as compared to the on-the-ground mapping. The Draft EIS also states that the extent of impacts to jurisdictional wetlands and other waters is likely an overestimate because actual construction footprints will be smaller than presented in the document and because some mapped wetlands and waters could be non-jurisdictional (p. 12-147). However, in some areas, when compared for other projects (e.g., Delta Wetlands project EIS) the extent of potential wetlands and waters mapped for BDCP is substantially lower. While the extent of ground disturbance may be overestimated in the document, it is likely that the extent of wetlands and waters have been substantially underestimated.

Recommendations**:** *In Section 12.3.2.4, clearly describe how the GIS-based mapping compared to the field delineations and provide an estimate of GIS mapping accuracy. Use available approved wetland delineations from other projects to supplement the GIS mapping.*

Identify a schedule for improving delineation methods completing wetland delineations on sites where DWR has access or can reasonably obtain access. Estimate direct fill impacts and secondary effects to waters using engineering drawings and cross sections.

L. Air Quality Impacts

General Conformity
The Draft EIS discloses that this project would generate emissions within multiple air basins that are federally designated as nonattainment for ozone, PM2.5 (particulate matter smaller than 2.5 microns), and/or PM10 (particulate matter smaller than 10 microns); as well as designated maintenance areas for

[27] See Corps comments on the Draft EIS July 16, 2014 and July 29, 2014

carbon monoxide (CO; p. 22-13, Table 22-4). The Draft EIS states that general conformity to the State Implementation Plan (SIP), with regard to all of these pollutants except CO, would be demonstrated through the use of a combination of mitigation measures and the purchase of offsets. For CO, conformity would need to be demonstrated through the use of local air quality modeling analyses (i.e., dispersion modeling).

The availability of sufficient offsets to demonstrate conformity for the BDCP may be limited. EPA is aware that other construction projects scheduled to take place in the BDCP project area during the BDCP's proposed construction time frame also include the purchase of offsets to demonstrate conformity. For example, two segments of the California High Speed Rail project scheduled to be constructed in the San Joaquin Valley Air District are currently pursuing a significant amount of offsets for several criteria pollutants.

The Draft EIS is not clear as to whether the federal lead agencies have made a general conformity determination. To the extent there is information regarding conformity, the Draft EIS also appears to rely on qualitative, not quantitative information. EPA interprets the general conformity rule as including all direct and indirect emissions from the federal action; therefore, the emissions from all conservation measures required as part of this federal action should be quantified and evaluated in the general conformity determination.

Recommendation: *Demonstrate that all direct and indirect emissions of the federal action, including all required conservation measures, would conform to the applicable SIPs and not cause or contribute to violations of the National Ambient Air Quality Standards (NAAQS).*

Continue to work closely with the local air districts to secure legally binding offset agreements and complete the general conformity determinations.

Include the Draft General Conformity Determination either as a detailed summary or as an appendix, and the previously referenced "Conformity Letters."

IV. Additional Issues

A. Alternatives

The reason for including maximum pumping capacity (10,600 cfs) for the State Water Project's Banks Pumping Plant in all CM1 alternatives that include north Delta intakes is not clear. The existing pumping restriction for Banks Pumping Plant for the gates of Clifton Court Forebay is intended to minimize erosive forces. Section 5.2.1.3 refers to the Corps of Engineers' Public Notice for the Bank Pumping Plant, which states that that additional permitting for the SWP's diversions would not be required so long as the SWP did not exceed a diversion of 13,250 acre feet (daily and 3-day running average). It is not clear that the Corps' goal of minimizing erosion would be met by full pumping capacity operation.

Recommendations: *Describe the Corps of Engineers' pumping restriction for the Banks Pumping Plant. Describe the circumstances under which the Banks pumping plant would be able to pump at maximum capacity, and why erosion would no longer be a significant effect from pumping.*

The description of CM2 (Yolo Bypass fisheries enhancement) in Section 3.6.2.1 (p. 3-122) does not contain information about the amount and location of planned restoration activities, disclosure of targeted flood frequency, or a description of how CM2 differs from what is already required of the Bureau of Reclamation by the 2009 NMFS Biological Opinion, Section I.6.1 (page 34 in the 2009

Biological Opinion with 2011 amendments). That Biological Opinion requires Reclamation to "provide significantly increased acreage of seasonal floodplain rearing habitat, with biologically appropriate durations and magnitudes, from December through April, in the lower Sacramento River basin, on a return rate of approximately one to three years, depending on water year type." The Biological Opinion indicates that the amount of floodplain restoration should range between 17,000-20,000 acres (excluding tidally-influenced areas), with appropriate frequency and duration.

It is EPA's understanding that CM2 is evaluated programmatically and subsequent NEPA document(s) will further define aspects of this alternative. Indeed, the Bureau has already collected scoping comments for the development of an EIS specific to CM2. It is not clear how programmatic information from this Conservation Measure was used to inform project-level impact determinations for Chapter 5 through Chapter 11 in the current Draft EIS.

Recommendations: *Provide additional available information about the planning of CM2, including floodplain acreages, frequency and duration of estimated inundation, and maps of potential locations of restoration sites.*

Summarize the potential overlap between CM2 and Section I.6.1 of the 2009 Biological Opinion so that the reader is informed about the existing requirements under Section 7 of ESA and how actions taken or proposed pursuant to the Biological Opinion may be modified by the BDCP.

Indicate whether additional water would be needed to flood the Yolo Bypass and, if so, where the water would come from.

Explain how programmatic information drawn from this Conservation Measure was used to inform project-level impact conclusions for water supply and water quality.

Recent floodplain habitat loss over the last few decades is listed as one of the reasons for proposing CM2, however, floodplain habitat loss has been occurring for more than a few decades.

Recommendations: *Provide a broader description of long-term floodplain habitat loss over a 100 year timeframe and describe how it has affected fisheries populations, with appropriate citations.*

It does not appear that a feasibility analysis was conducted to determine the availability of lands for restoration within the Restoration Opportunity Areas for CMs 2, 4-11. We understand that much of this information is confidential; however, there are multiple other draft HCP efforts moving forward that overlap with the project area, creating the potential for restoration planning conflicts on the same parcel of land.

Recommendation: *Conduct an analysis of areas that support each type of proposed habitat restoration in each of the Restoration Opportunity Areas and develop criteria for prioritizing acquisition based on potential restoration success and availability. Consider the other draft HCP efforts that overlap or are immediately adjacent to the project area to identify potential conflicts on restoration areas*.

The Draft EIS does not include a comprehensive description of the CVP and SWP with and without new north Delta intake facilities or through-Delta operations. Such information is needed to assist the reader in understanding how the water delivery system operates under Existing Conditions and how it would change under CM1 alternatives.

Recommendation: *Include a description of existing CVP and SWP operations in the Chapter 3 discussion of the No Action alternative, including how operations would change or remain static under each proposed alternative.*

The North Delta Bypass rules are difficult to understand and should be more clearly explained, particularly in the context of how flows occur currently (p. 3-181-3-209). Listing the rules does not enable the reader to understand how the new facilities would operate within the CVP and SWP system and, subsequently, how the new rules could modify the Sacramento River where new intakes would be placed and operated.

Section 3.6.4.2 provides only an annual average of how often the north Delta intakes would be used versus the south Delta intakes. For the reader to understand how the system would work, information about the potential timing, frequency, and duration of operation of each of the pumps throughout the year would be more useful.

Recommendations: *Provide information and references that describe current CVP and SWP operations. Describe modifications to reservoir operations to avoid dead pool conditions for all alternatives.*

Clearly state that BDCP's North Delta Bypass rules are intended to protect flows from only one storm pulse or, potentially, two storm pulses if the first storm arrives before December 1st. Explain that subsequent storm pulses (that are important fish cues for migration) can be exported after BDCP's new operational rules have been met.

Provide information about the potential timing, frequency, and duration of operation of each of the pumps throughout the year, including when and the conditions under which each pump would be used alone or simultaneously with the other.

Provide information about Sacramento River flows to put the North Delta Bypass rules in context. For example, describe how often flows are at the levels used as thresholds in the bypass rules to help the reader to generally understand how much flow would remain in the river versus be diverted into the new intakes. Also provide exceedance curves of Sacramento River flows and the Post Pulse Water Operations for each CM1 alternative, and consider including a chart that summarizes information in Table 3-16 (p. 3-183) describing Post Pulse Water Operations, and include Sacramento River flows for comparison.

The Export/Import ratio (also known as Export Limits in Table 3 of the Water Quality Control Plan) does not necessarily solely apply to the south Delta or explicitly exclude new points of diversion. The description of how the export/import ratio from the 1995 Bay-Delta WQCP is included in operational requirements and impacts from the CM1 alternatives (p. 3-32) may not be consistent with the description of the E/I ratio as interpreted by NMFS.[28]

Recommendation: *Describe how the E/I ratio was used in evaluations of each operational scenario for the alternatives. If the approach ultimately used in the analysis differs from the D-1641 approach, explain the reason(s) for, and implications of, using the different approach.*

[28] See NMFS Progress Assessment p. 10 http://baydeltaconservationplan.com/Libraries/Dynamic_Document_Library/NMFS_Progress_Assessment_Regarding_the_BDCP_Administrative_Draft_4-11-13.sflb.ashx

State whether or not project proponents will request that the State Water Board modify the existing E/I water quality standard so it does not apply to the north Delta intakes and describe the process for having that modification approved.

Information that provides context for the Fremont Weir and Yolo Bypass Operational Criteria should be provided in the section that generally describes these operational criteria (p. 3-187). In the absence of context, it is unclear how the rules would change. For example, with no information about how often Sacramento River flows at Freeport are expected to be greater than 25,000 cfs, it is unclear how often the 17.5 and 11.5-foot elevation gates would be open and how often the Yolo Bypass floodplain restoration work would provide benefits to aquatic life using these resources.

Recommendations: *Provide cumulative distribution curves that show expected flows at Freeport under each CM1 alternative for each type of water year. Discuss the curves in the text and identify the median frequency at which Sacramento River flows at Freeport are expected to be greater than 25,000 cfs.*

Provide maps showing Yolo Bypass inundation of 3,000 to 6,000 cfs.

The Fremont Weir is described as a necessary component of CM1; however, the Draft EIS states that "CM2 is a programmatic element that will be further developed and analyzed in future technical and environmental reviews." The impacts associated with this element are not estimated and disclosed in the Draft EIS. For example, although Fremont Weir gate operational rules were developed for the purposes of modeling, the impacts of the proposed operation of the Fremont Weir do not appear to have been analyzed. Without such analysis, the impacts of CM1 cannot be fully evaluated.

Recommendation: *Describe the updates to Fremont Weir that would take place under all of the Alternatives.*

The Rio Vista Minimum Instream Flow Criteria shown on p. 3-188 are substantially different from the Rio Vista flow criteria in the 2006 Bay-Delta WQCP, which are implemented through water right permit D-1641. It is not clear how the BDCP process would result in a change to the Bay-Delta WQCP water quality standards and the water right permit.

Recommendations: *Describe the Rio Vista flow criteria in the 2006 Bay-Delta WQCP and the D-1641 permit requirements. Describe the difference in flows proposed by the BDCP and explain how they would be attained.*

If it is anticipated that water quality standards would be modified subject to a request connected to the implementation of BDCP, describe the process by which the modification would be requested and processed by the State Water Board.

The discussion in Section 5.2.2.2 "The Revised Water Quality Control Plan (2006)" does not reflect substantial work the State Water Board has completed or undertaken relevant to the 2006 Bay Delta WQCP, including the 2009 Triennial Review and its conclusions, the 2010 Flow Criteria Report, and the Phase I and Phase II Updates to the 2006 Bay-Delta WQCP. These updates include potential modifications to San Joaquin River tributary and lower San Joaquin River flows, Delta outflow objectives, export/inflow objectives, Delta Cross Channel Gate closure objectives, Suisun Marsh objectives, potential new reverse flow objectives for Old and Middle Rivers and potential new floodplain habitat flow objectives. Under recent state legislation, the State Water Board will also be evaluating changes to outflow requirements for major Delta tributaries. Although the outcome of these

State Water Board regulatory processes is unknown at this time, it is reasonable to expect that all will have significant impacts on BDCP planning and implementation.

Recommendation: *Summarize the current status of the State Water Board's update to flow objectives, including export limits and minimum Delta outflows. Updated objectives should be considered in the impacts analyses, and the document should describe how any proposed or pending updates to flow standards may affect the analyses and the implementation of the BDCP. Describe the mechanisms that would be in place in the BDCP, the Implementation Agreement or other BDCP agreements to assure implementation of future SWRCB water quality and water rights actions.*

B. Water Supply

We are concerned that the "Overview of California Water Demand" discussion in Section 5.1.1.3 provides an incomplete summary of water demand in California. For example, population growth is discussed as a reason for increasing urban water demand (p. 5-4); however, there is no reference to the statewide mandate to increase water efficiency 20% by the year 2020 for urban water uses, which is discussed in appendices to other chapters. Details are not provided regarding the rate of urban water demand growth or estimated urban water demand and use, and no basis other than population growth is provided for the conclusion that water demands will increase. Similarly, the importance of water to the agricultural economy is discussed (p. 5-4); however, there is no discussion about the importance of water to other economic sectors.

Municipal and industrial (M & I) demand north of the Delta was estimated by assuming full build out of facilities associated with water rights and contracts north of the Delta, primarily to meet projections of increasing urban water demand (p. 5-57). It is not clear whether the 81% estimated increase under the No Action Alternative, compared to Existing Conditions, takes into consideration the required water efficiency efforts for municipal and industrial water use (see table 5-8). This is important because "increased system demands by water rights holders, especially in El Dorado, Placer, and Sacramento counties" is identified as a reason for projected decreases in reservoir storage and CVP and SWP deliveries under the No Action Alternative (p. 5-61 through 5-64). An overestimation of M & I demand would result in exaggerated projected decreases in water availability for those other uses.

Recommendations: *Modify Table 5-1 to include sectors of consumptive water use, average water use in each category, and estimated rates of growth in each category.*

Summarize the information in Table 5-1 in the text of Section 5.1.1.3.

Provide an overview of water demand in California that summarizes water use by sector (e.g., urban, agricultural, industrial), discloses the economic value generated by each sector, and estimate the rates of water demand growth in each sector.

Clarify whether or not the 2010 urban water efficiency mandate of a 20% reduction in M & I water use by 2020 is included in estimates of future water demand. If it is not included in water demand estimates, explain why it is excluded in the context of the potential impact of overestimating demand on BDCP estimates of water supply effects.

Evaluate water supply effects of CM1 scenarios using several configurations and success rates of CM4, and disclose methods and results.

C. Groundwater

The Draft EIS describes beneficial impacts on groundwater resources for some alternatives as a result of CM1 (p. 7-54). It states that for all alternatives, increases in surface water supplies as a result of BDCP would result in diminished use of groundwater (p.7-84); however, no documentation is provided to support this assumption.

The Draft EIS states that groundwater use in the San Joaquin River area is estimated to be between 730,000 and 800,000 acre-feet per year, which exceeds the basin's estimated safe yield of 618,000 acre-feet per year and that each groundwater basin has experienced some overdraft (p.7-18). The Draft EIS also states that the estimated overdraft is between 1 and 2 million acre-feet annually, with many basins in Tulare Lake Basin in critical condition (p.5-4). The Draft EIS assumes that these overdrafts would stop after implementation of the BDCP. On the contrary, we believe it is reasonable to expect that provision of more water could result in more water being used, including as much groundwater as allowed, rather than in strict substitution of surface water for groundwater. Without management of groundwater resources, it is not clear that the pressure on groundwater resources would be diminished as a result of the BDCP.

Recommendations: *Explain the basis for the assumption that increases in surface water supplies would result in diminished use of groundwater. The likelihood and potential impacts of increased use of surface water supplies for aquifer storage and recovery should be discussed.*

Consider development of a mitigation measure to address management of groundwater resources in the southern San Joaquin Valley.

D. Water Quality

Reporting methods for the chloride and EC analyses may partially obscure conclusions about the predicted range of salinity intrusion, chloride, and EC concentrations for existing conditions, the No Action Alternative, and CM1 alternatives. The chloride modeling analysis (Appendix 8G) provides a 16-year average of estimated chloride concentrations, a 5-year drought average chloride concentration, and a percent exceedence of the minimum health objective of 250 mg/L chloride. Combining 16 years of water quality data and reporting the average omits the predicted range of maximum mean daily chloride concentrations predicted for each of the compliance points under various alternatives compared to their baselines. Averages can mask the severity of chloride and EC concentrations by allowing wet years with lower salinity (chloride and EC) levels to balance dry years with higher salinity concentrations. The 5-year drought average provides some indication for time periods when increased salinity concentrations are expected; however, elevated EC and chloride concentrations at certain compliance points may also occur in above normal and below normal years following dry years.

The reason for, and consequences of, constraining the water quality analysis by using a 16-year hydrology modeling period is not described in the Draft EIS nor its appendices. The 16-year hydrology period extends from 1975 to 1991 and includes a drought period and the highest water year recorded in recent decades (1982). If this hydrology period is different than other periods that could have been chosen or the entire 82-year period available for modeling, results of the water quality analysis may be inaccurate.

Recommendation: *Explain why the 16-year period was used and the 82-year period was not used, and describe the potential impacts on the precision of the water quality effects predicted by the modeling exercise reported in the Draft EIS Chapter 8 appendices and summarized in the text of the Draft EIS. Compare the 16-year hydrology period (1975-1991) to the entire hydrology period available, disclose*

that comparison to the public and decision-makers, and explain how the smaller time period may influence water quality predictions.

The assertion that water demand will go down in the Tulare basin, in the face of large increases in population, is not thoroughly supported (p. 30-31). This is stated to be the expected result of a decrease in agriculture (now using 82% of the water p. 30-32), but it is not a given that the acreage in agriculture would decrease when additional water resources become available as a result of BDCP. Rather, increases in both population and agriculture are plausible.

Recommendations: *Include a discussion of growth that considers the potential for increases in both urbanization and agricultural development in response to increased reliable water supplies, and that addresses the entire San Joaquin Valley. Include an explanation of why additional water resources are needed (p. 5-4) if projected urbanization would use less water (p. 30-11).*

Water Quality Impact Conclusion WQ-26 (effects on selenium concentrations resulting from restoration activities) lists impacts before mitigation, as "Less Than Significant." After mitigation, conclusions are "Less Than Significant" and "Not Adverse." Analysis of residence time for planned remediation efforts is not quantitative and, therefore, lacks sufficient resolution to substantiate impact conclusions.

Recommendation*: Re-analyze Impact WQ-26 based on quantitative measures of residence time and selenium bioaccumulation that: (1) include specificity of locations and species, and (2) reflects current science that assesses the Delta as one interconnected system physically and biologically.*

Consider making the environmental commitments for selenium in restored areas a high priority by addressing these impacts within the main water quality and aquatic resources part of the EIS. Clearly identify the potential impacts of using water supplies containing selenium for wetlands with high residence times and selenium risks to fish and wildlife.

Selenium bioaccumulation modeling for sturgeon is shown in Appendix 8M2, but an impact conclusion is not listed within the category of impacts to white and green sturgeon (e.g., AQUA-136). Other identified species considered of concern in terms of selenium effects, for which no conclusions are provided, are diving ducks (scoter and scaup), clapper rail, salmonids (Chinook salmon, steelhead) and splittail.

Recommendations*: Provide an impact analysis for these species, and add impact conclusions for these species to the category of Fish and Aquatic Resources impacts.*

Illustrate and conceptualize mixing of selenium sources. Document representativeness of sites to selenium modeling to enable coordination of site locations to modeling predictions.

Perform selenium bioaccumulation modeling to specifically address the potential for (1) less Sacramento River flow (i.e., less estuary dilution and increased residence times), and (2) more San Joaquin River flow (increased Se loads or concentrations) entering the Plan Area. Perform an analysis that is both species-specific and location-specific, and develop habitat-use and life-cycle diagrams to inform the selenium modeling. Identify the times and places of greatest ecosystem sensitivity to selenium as outcomes of the modeling and relate the outcome to the entire plan area. Add selenium bioaccumulation modeling of additional fish and bird species to identify the predators with the greatest selenium exposure within fish and bird communities. Development of a comprehensive set of enrichment factors to relate dissolved selenium concentrations to suspended particulate material selenium concentrations would address the uncertainty in this step of selenium modeling.

The data sets that were used to model selenium in sturgeon and derive impacts are not spatially and temporally matched. Locations in the western Delta are ecologically and hydrologically disconnected from the Bay, where effects to sturgeon are known to be greatest.[29]

***Recommendation**: Consider comprehensive sturgeon habitat and cumulative effects in selenium modeling and impact analysis*.

The multiple times that eutrophication is mentioned on page 8-70 (Section 8.2.3.1.0 Nitrate/Nitrite and Phosphorous) may suggest to some readers that the San Francisco Estuary is suffering from large-scale eutrophication. Currently, eutrophication is not one of the major stressors negatively affecting the open waters of the San Francisco Estuary.

***Recommendations:** Clarify that monitoring shows that the open waters of the San Francisco Estuary do not show signs of large-scale eutrophication and that anoxic waters and sediment are not commonly reported in the Estuary. Identify the sites with demonstrated low dissolved oxygen problems and describe the extent to which nutrients, subsequent algal blooms, and microbial respiration contribute to low DO problems in the Estuary.*

Discuss the lack of diatom algal blooms as a stressor in the Estuary and the relationship between nutrients and the composition of the algal community and subsequent frequency of desired algal blooms. This can be a short summary in a few sentences and can refer to other locations in the document where nutrients and algal community composition is discussed in more detail. See http://www.sfestuary.org/pea-soup/ for more information.

E. Fish and Aquatic Resources

The temperature analysis does not provide biologically meaningful temperature estimates for Chinook salmon and, potentially, other fishes. The majority of temperature estimates are calculated using models that predict monthly average temperatures which can obscure the occurrences of daily temperatures fluctuating above life stage impairment and lethal thresholds for Chinook salmon and other fishes. Daily temperatures are estimated for the mainstem of the upper Sacramento River in the segment downstream of Keswick dam because a model with a daily time unit of analysis is available for this exercise (Sacramento River Water Quality Model). Temperature models with a daily time unit are not yet available for the Feather, American, lower Sacramento, and Trinity Rivers, but we understand Bureau of Reclamation is developing daily temperature models as part of the OCAP Biological Opinion remand process. Completion of these models should be prioritized and used in any additional analyses to provide meaningful estimates of temperature impacts to fishes.

***Recommendations:** Estimate potential temperature impacts when updated models become available. Identify temperature thresholds for specific life stages based on NMFS recommendations and other available guidance; for example, EPA temperature criteria. Identify mitigation measures that would minimize adverse temperature conditions.*

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[29] (1) Linares, J., Linville, R. Eenennaam, JV, Doroshov, S. 2004 Selenium effects on health and reproduction of white sturgeon in the Sacramento-San Joaquin estuary. Final Report for Project No. ERP-02-P35.
(2) Linville RG 2006 Effect of excess selenium on the health and reproduction of white sturgeon (*Acipenser transmontanus*): Implications for San Francisco Bay-Delta. Ph.D. dissertation, University of California, Davis, CA 232 pp.
(3)Beckon, WN & Maurer, TC, 2008 Species at Risk from Selenium Exposure in the San Francisco Estuary. Final Report to the US EPA IAA No. DW14022048-01-0.
(4) Presser TS and Luoma SN 2010 Ecosystem-Scale Selenium Modeling in Support of Fish and Wildlife Criteria Development for the San Francisco Bay-Delta Estuary, California USGS Administrative Report.

EPA Region 10 developed EPA Guidance Criteria for Water Temperature[30] to assist States and Tribes in adopting water quality standards for the protection of coldwater salmonids. The guidance criteria provide an averaging period for temperature targets and would be an appropriate benchmark against which to evaluate estimated impacts from CM1 alternatives, in addition to the evaluated criteria summarized in Table 11-1A-11.

Recommendation: *Compare impacts from CM1 and other CMs with the potential to impact water temperatures to EPA Guidance Criteria for Water Temperature to provide an additional metric for estimated impacts to Chinook salmon.*

The Draft EIS assumes that state-of-the art fish screens would function in a way that results in minimal to zero entrainment, but provides no evidence that these screens would completely or almost completely prevent entrainment of larval, juvenile, or adult covered fishes. No details are provided regarding the design or operation of the proposed fish screens.

Recommendation: *Explain how the proposed fish screens would prevent entrainment of all life stages of covered fishes. Describe the entrainment thresholds that would trigger reduced pumping at the North Delta Diversion intakes, and mitigation strategies for minimizing entrainment if the fish screens do not function as anticipated.*

The construction analysis relies on Best Management Practices for concluding that potential impacts to aquatic species would not be adverse. The construction is estimated to span ten years, coffer dams are expected to be constructed simultaneously, and potentially increasingly severe weather conditions during the ten-year construction period are likely to challenge the most effective Best Management Practices. Additionally, some of the equipment that would need to be constructed (including the dual 40 foot wide tunnel boring machines) would be some of the largest in the world and the Best Management Practices that have been designed for more conventional construction projects may not be applicable or effective as anticipated.

Recommendation: *Describe options for minimizing construction impacts in the event that BMPs do not perform as anticipated or completely fail, given the size and scale of the construction.*

NEPA effects determinations used in Chapter 11 include: beneficial, not adverse, adverse, and no determination. These terms are not defined nor are thresholds for selecting among them identified. The reader is not provided with an indication or description of the magnitude of estimated positive or negative impacts or uncertainty associated with each conclusion.

Recommendation: *Define the NEPA conclusions and provide thresholds -- quantitative when possible -- for each category so that it is clear why some estimated impacts result in a NEPA conclusion.*

Multiple indicators are used to evaluate impact and derive NEPA Effects determinations; however, the Draft EIS does not describe how each indicator was used to support the NEPA effects determination. For example, AQUA-42 Effects of Water Operations on Conditions for Chinook salmon (Winter-Run ESU) uses nine indicators to determine the overall effect of CM1 alternatives on adult and juvenile migration for winter run Chinook salmon. We have summarized key information from this section in the following table:

[30] http://www.epa.gov/region10/pdf/water/final_temperature_guidance_2003.pdf

AQUA-42 Effects of Water Operations on Conditions for Chinook salmon (Winter-Run ESU)

Migration Indicators	**Alt 1**	**Alt 4**	**Alt 7**	**Alt 8**
Upstream of Red Bluff flow during juvenile emigration period (Nov – August)	Similar to No Action Alternative (NAA) July & October + 36% Aug, Sept, & Nov -44%	Similar to NAA November 5-18% lower	Similar to NAA November -14%	Flows 26% lower than NAA
Monthly mean temperature between Keswick and Bend Bridge (Nov – Aug)	Less than 5% difference in monthly mean T relative to NAA	Less than 5% difference in monthly mean T relative to NAA	Less than 5% difference in monthly mean T relative to NAA	Less than 5% difference in monthly mean T relative to NAA
Flow during adult migration (Dec – Aug)	Similar to NAA; August flows could be 19% lower.	Similar to NAA but May & June +12%	Similar to NAA or greater w/ few (unstated) exceptions.	Similar to NAA but up to 18% lower in July and August
Monthly mean T btw Keswick and Bend Bridge (Dec – Aug)	Less than 5% difference in monthly mean T relative to NAA	Less than 5% difference in monthly mean T relative to NAA	Less than 5% difference in monthly mean T relative to NAA	Less than 5% difference in monthly mean T relative to NAA
Through-Delta Monthly mean flows downstream of NDD	10-31% lower than NAA	11-23% lower than NAA	25% lower than NAA	15% lower than NAA in November
Predation at intakes % of annual juvenile production (2 methods)	9%-3% 18.5%	0.02 – 0.30% 12%	0.02 – 0.30% 12%	0.02 – 0.30% 11.6%
	19,000 linear feet 22 acres of habitat	6360 linear feet 12.3 acres	6360 linear feet 12.3 acres	6360 linear feet 12.3 acres
DPM analysis of % survival through the Delta to Chipps	Wet – 45.5% Dry – 26% All – 33.3%	Wet – 45-46% Dry – 25-27% All – 33-35%	Wet – 45% Dry – 26% All – 33%	Wet – 44% Dry – 27% All – 33.5%
Adult migration -- % of Sacramento River-origin water at Collinsville	December – 63% January – 71% February – 67%	December – 66% January – 73% February – 68%	December – 65% January – 73% February – 67%	Results not provided for Alt 8 but a range of 58–71%
NEPA Effects Determination	**Adverse**	**Not Determined**	**Not Determined**	**Adverse**

It is not clear whether all nine indicators are considered equal when identifying the NEPA effect determination for migration overall. The monthly mean temperatures do not substantially vary among alternatives, so that indicator appears to be less useful than the others in differentiating between the alternatives. Some indicators show improved conditions relative to the No Action Alternative, while others show relatively worse conditions. For some indicators, the level of detail that is provided in the text differs from one alternative to another. The narrative descriptions of the multiple indicators in the NEPA Effects paragraphs often highlights different indicators when discussing the NEPA Effects determination, suggesting that some indicators are more important than others, depending on the alternative being evaluated. The reader sees only the summarized results of multiple indicators but cannot ascertain how the information was used to determine NEPA effects.

Recommendation: *Explain how each metric was used, and how the metrics were used in combination, to derive the NEPA Effects determinations, including whether the metrics were weighted in any way. Thresholds that were used to determine the appropriate NEPA Effects conclusion should be disclosed.*

The description of Clean Water Act programs in the Water Quality Regulatory Setting Section 8.3.1.1 (p. 8-112-114) contains a number of errors. For example, it appears to indicate that EPA has delegated its CWA oversight responsibility to the State of California. A useful description of CWA programs and how they operate in the San Francisco Bay Estuary can be found in the US EPA Advance Notice of Proposed Rule-making for Water Quality Challenges in the San Francisco Bay/Sacramento San Joaquin Delta, available at http://www2.epa.gov/sites/production/files/documents/baydeltaanpr-fr_unabridged.pdf pages 11-18.

Recommendation: *Review the description of CWA programs in the San Francisco Bay Delta Estuary and California.*

It appears from the Draft EIS that there could be significant impacts to vernal pools from implementation of CM1 and CM4. Impacts and mitigation for vernal pools are only presented as "vernal pool complex" and it is not clear from the document what percentage of this habitat is vernal pool wetlands (wetted surface area).

The Draft EIS states that implementation of CM4 may result in the loss of 372 acres of vernal pool complex habitat and CM1 could result in up to an additional 37 acres of loss (depending on alternative). With the information in the Draft EIS we cannot assess what proportion of these impacts are to wetlands. The document also states that AMM12 limits removal of "vernal pool crustacean habitat" to 10 wetted acres. However, it is not clear if all vernal pool wetlands are being considered "crustacean habitat." According to the document, these 10 wetted acres of crustacean habitat equates to approximately 67 acres of "vernal pool complex" habitat. The 67 acres of impact allowed by AMM12 is significantly less than the 372 acres of potential loss identified for CM4.

Because the Draft EIS only presents theoretical footprints for tidal marsh restoration under CM4, it is unclear whether CM4 can be fully implemented while limiting vernal pool loss to 10 wetted acres as called for under AMM12. As the Draft EIS acknowledges, vernal pools are a highly sensitive community that has experienced significant loss in California. Yet, only 40 acres of restoration and 400 acres of protection are proposed in the near-term under the plan. Given the potential direct loss identified for CM1 and CM4, and the potential functional loss identified from implementation of CM2, the proposed vernal pool restoration may not be sufficient to meet mitigation needs under CWA Section 404. Mitigation needs cannot be fully assessed until project level information is available for all CMs.

Recommendations: *Clearly state what percentage of the vernal pools complex habitat may be vernal pool wetlands (by wetted surface area). Clarify whether AMM12 applies to all vernal pool wetlands or only vernal pool wetlands occupied by special status crustaceans.*

Clearly state how many acres of vernal pool wetlands may be lost from implementation of CM1 and CM4. Clarify whether it is feasible to fully implement CM4 while limiting vernal pool losses to 10 wetted acres and if there is a tradeoff, please disclose and discuss.

Quantify the potential functional loss to vernal pool habitat from changes in inundation and acknowledge that compensatory mitigation may be required for loss of function even if there is no net loss in area. Acknowledge and address that compensatory mitigation requirements under CWA Section 404 maybe greater than the vernal pool complex restoration and protection proposed under the plan.

Appendix 3B details dredged material (DM) and reusable tunnel material (RTM) disposal and reuse commitments, among other environmental commitments. Neither Appendix 3B nor Chapter 3 details how much DM and RTM will be generated by each alternative; however, Chapter 12 identifies potentially significant impacts to wetlands and waters from disposal of this material. Impacts to jurisdictional wetlands and waters must be avoided and minimized to the maximum extent practicable consistent with the 404 Guidelines. Furthermore, the Draft EIS does not address the Delta Long Term Management Strategy (LTMS)[31] goal to maximize beneficial reuse of DM by setting specific reuse targets for both DM and RTM. Appendix 3B states that material will be placed in multiple storage locations and reused in BDCP projects to the extent feasible, however, there are potentially many other construction and restoration projects in the Delta that could use the DM and RTM. If material will be placed in waters either temporarily or permanently, sediment testing will need to be coordinated with the Corps, EPA, and Regional Water Quality Control Boards.

Recommendations: *Include the volume of DM and RTM in Chapter 3 and Appendix 3B. In Appendix 3B clearly state that placement of DM and RTM must comply with the CWA 404(b)(1) Guidelines, in addition to meeting to BDCP goals.*

Discuss beneficial reuse goals for DM and RTM, including whether material will be made available for reuse in projects within and outside the BDCP.

Discuss whether placement of DM and RTM on peat soils, either temporarily or permanently, will further subsidence and undermine levee stability.

Clearly identify accessibility of placement sites and commit to promoting beneficial reuse of DM and RTM both within and outside BDCP projects.

For any material placed in waters, clarify that sediment testing must be coordinated with the USACE, EPA, and RWQCB.

F. Energy

The Draft EIS states that conveyance facility energy requirements are moderate and would not result in any substantial impacts (p. 21-25). The cumulative impacts analysis concludes that, while the cumulative energy demands of the BDCP, in combination with ongoing and reasonably foreseeable

[31] The San Francisco Bay Long Term Management Strategy (LTMS) is a cooperative effort of EPA, the US Army Corps of Engineers, the San Francisco Regional Water Quality Control Board, the San Francisco Bay Conservation and Development Commission, and stakeholders in the region to develop a new approach to dredging and dredged material disposal in the San Francisco Bay area. The LTMS serves as the "Regional Dredging Team" for the San Francisco area, implementing the National Dredging Policy in cooperation with the National Dredging Team.http://www.epa.gov/region9/water/dredging/ltms/index.html

future projects, may affect regional resources, the increase attributable to any alternative is not cumulatively considerable, compared to statewide use (300,000 gigawatt-hours) (p. 21-61). A comparison only to statewide use does not provide sufficient context for decision makers and the public to understand the new energy demands associated with the BDCP alternatives and evaluate their potential effects on local and regional energy supplies.

Recommendations: *Include a table showing the current overall energy usage by the CVP and SWP to supply water to the end users, compared to the projected overall energy demand by the CVP and SWP to do the same under the No Action and each of the BDCP build alternatives. Separately, for additional context, compare these projections to recent and reasonably foreseeable development projects, including the High Speed Rail project. Include an evaluation of the effects of each alternative on peak and base period demands, as well as effects on local and regional energy supplies, as recommended by the State CEQA Energy Conservation Guidelines (Appendix F).*

EPA supports the use of gravity-fed tunnels to transport water to minimize net energy use for conveyance to the greatest extent possible. Alternative 4 is designed to take greater advantage of gravity than the other alternatives. According to the Draft EIS, the Department of Energy has estimated that construction of two 40-foot tunnels (Alternative 4) would require about 78% more electrical energy than would be needed for alternatives requiring two 33-foot tunnels (p. 21-31 and Table 21-9); however, since Alternative 4 would eliminate the need for an intermediate low-head pumping plant for flows of more than 9,000 cfs (p. 21-31), Alternative 4 would be able to 'recover' the extra energy used during construction in 25 years. It is not clear why the 33-foot tunnel alternatives do not include gravity-fed designs.

Recommendations: *Discuss the practicability of increasing the energy head (difference in water elevation) between the intermediate Forebay at the north of the Delta and the Clifton Court and Byron Forebays to allow for greater gravity-fed flow through the 33-foot tunnel alternatives. Discuss whether 9,000 cfs could be achieved without the need for intermediate low-head pumping through 33-foot tunnels.*

Consider alternate locations for the intakes, including upstream of the Sacramento Regional Wastewater Treatment Plant, and evaluate whether an increase in the energy head between the alternative north end intake locations and the south end of the proposed conveyance system could decrease net energy use for each alternative.

Include a table that demonstrates, for each alternative, the time that would be needed to 'recover' the energy used during construction. Incorporate into the table any additional alternatives that would minimize net energy use, and the time to 'recover' energy used during their construction. As part of the same table, include the overall energy for construction and operation of the BDCP for the total expected life of the project.

EPA strongly supports the goal, stated in the Draft EIS, to power the BDCP's average 270 megawatt (MW) construction load and 57 MW permanent load with 100% renewable energy (p. 21-33). This would avoid emissions of greenhouse gases and other pollutants associated with the generation of energy from fossil fuels. We find, however, that the Draft EIS defers much of the necessary analysis of renewable energy benefits, challenges, and opportunities to the future development of other documents, and lacks clear commitments regarding procurement of renewable energy. For example, regarding construction, Mitigation Measure AQ-15 in Chapter 22 includes a suite of greenhouse gas emission reduction strategies that would be utilized to develop a future GHG Mitigation Program to reduce construction related GHG emissions to net zero (p. 22-75). At this time, it is unclear which strategies

would comprise the program and whether a commitment would be made to enter into a purchase agreement for 100% renewables (Strategy 1) or temporarily increase renewable energy purchases to offset BDCP construction emissions (Strategy 12).

Regarding operations, Chapter 21 of the Draft EIS explains that the energy needed for pumping water would be provided from a mix of hydro, power purchase contracts, power exchanges and power markets (p. 21-22). The Draft EIS notes that 60% of the State Water Project's (SWP) 2010 load was met by hydro resources, while the remainder of the load was met by a mix of coal power and real-time purchases from the California Independent System Operator's (CAISO) energy market (p. 21-7). According to Chapter 21, the potential for new or expanded electrical power generation facilities is not discussed in the Draft EIS because it will be addressed through SWP power purchase programs (p. 21-33). Similarly, new energy sources to support the potential increased load from the Central Valley Project (CVP) are not discussed in the Draft EIS. It is unknown what type of power source (e.g., renewable, natural gas) would be substituted for the CVP-generated electricity that would be consumed by the project, itself, or to what extent some of additional energy required would be made up with higher efficiency (p. 22-198).

The Draft EIS references DWR's Climate Action Plan, which established near-term (by 2020) and long-term (by 2050) goals of reducing emissions of greenhouse gases throughout DWR's operations -- including those of the SWP -- in part, by increasing the use of renewable energy sources. Similarly, the President's June 2013 Climate Action Plan established a goal for the federal government of consuming 20 percent of its electricity from renewable energy sources by 2020.

Recommendations:
Identify opportunities to power the BDCP conveyance system with renewable energy for the life of the project to demonstrate how the stated goal of powering the anticipated construction and operations energy loads with 100% renewable energy could be met. Consider committing to power construction and/or the conveyance system operations with 100% renewable energy, similar to the CA High Speed Rail (HSR) Authority's commitment to use 100% renewable energy for operation of the HSR. At minimum, commit to ensure that construction and operation of the BDCP facilities are powered by renewable energy sources to the greatest extent feasible.

Discuss whether DWR's Renewable Energy Procurement Plan (REPP) would provide a mechanism to secure 100% renewable sources for construction and operations of the BDCP prior to project approval. Consider adopting an approach similar to the California High Speed Rail Authority's partnership with the National Renewable Energy Laboratory to create and implement a strategic energy plan for the BDCP. Outline the steps that would need to occur, the barriers that would need to be overcome and the potential for partnerships with entities in the vicinity of the Delta that are aiming to achieve similar goals.

Quantify how securing new,100% renewable energy sources for construction and operations of the BDCP would assist DWR in achieving its Climate Action Plan (CAP) goals. Discuss the extent to which hydropower resources will be used to meet the 2020 and 2050 goals in the CAP, and whether larger hydropower generators would qualify.

Discuss the extent to which the CVP is currently being used to meet California's renewable energy goals. To reduce potential indirect effects from substitute electricity for any new CVP energy usage, consider a commitment to ensure that new, renewable sources are secured to compensate for any use of CVP electricity for the BDCP.

Under the "NEPA Effects" section for each alternative in Chapter 21.3.3, the Draft EIS indicates that the use of Best Management Practices will ensure that only high-efficiency equipment is utilized during construction and that all feasible control measures to improve equipment efficiency and energy use are included. Similarly, it is noted that operation of the water conveyance facilities would be managed to maximize efficient energy use, including off-peak pumping and the use of gravity and, therefore, would not result in a wasteful or inefficient energy use. These conclusions are identical for every tunnel conveyance alternative.

Recommendations: *Explain how all of the energy efficiency mitigation measures and Best Management Practices referenced in Chapter 21 would be made an enforceable part of the project's implementation schedule. We recommend implementation of applicable mitigation measures prior to or, at a minimum, concurrently with, commencement of construction of the project.*

With regard to solicitations for future contracts for project construction and operations, consider including the following as energy efficiency requirements:

- *The use of energy- and fuel-efficient fleets;*
- *For construction, the utilization of grid-based electricity and/or onsite renewable electricity generation, to the extent possible, rather than diesel and/or gasoline powered generators;*
- *Using lighting systems that are energy efficient, such as LED technology;*
- *Recycling construction debris to maximum extent feasible;*
- *Planting shade trees in or near construction projects where feasible;*
- *Giving preference to construction bids that use Best Available Control Technology, particularly those seeking to deploy zero emission technologies;*
- *Employing the use of alternative fueled vehicles;*
- *Using the minimum feasible amount of GHG-emitting construction materials that is feasible;*
- *Use of cement blended with the maximum feasible amount of flash or other materials that reduce GHG emissions from cement production; and,*
- *Use of lighter-colored pavement where feasible.*

G. HCP Monitoring and Assessment

The BDCP is a project of such significance, with a reliance on extensive monitoring and technical information, that its development and approval represents an opportunity to advance aquatic resource monitoring for the entire state of California. For several years, EPA and partner state and federal agencies have been advancing a comprehensive monitoring program that supports integration of federal and state aquatic resource permitting for Habitat Conservation Plans (HCPs) and Natural Community Conservation Plans (NCCPs). When implemented as a monitoring program, the framework that has been established will generate information to evaluate site specific and regional outcomes of habitat conservation and aquatic resource mitigation activity. This framework has been created in consideration of the Clean Water Act (CWA) Mitigation Rule (33 CFR Parts 325 and 332; 40 CFR Part 230), the "Five Point Policy" (Addendum to the HCP Handbook), Tenets of a State Wetland and Riparian Monitoring Plan (CA Water Quality Monitoring Council 2010)[32], and Designing Monitoring Programs in an Adaptive Management Context for Regional Multiple Species Conservation Plans[33].

[32] Tenets of a State Wetland and Riparian Monitoring Program. 2010. California Water Quality Monitoring Council (CA Wetland Monitoring Workgroup). (http://www.waterboards.ca.gov/mywaterquality/monitoring_council/wetland_workgroup/docs/2010/tenetsprogram.pdf).

[33] Atkinson, A. J., P. C. Trenham, R. N. Fisher, S. A. Hathaway, B. S. Johnson, S. G. Torres and Y. C. Moore. 2004. Designing Monitoring Programs in an Adaptive Management Context for Regional Multiple Species Conservation Plans. U.S. Geological Survey Technical Report. USGS Western Ecological Research Center, Sacramento, CA. 69 pages. (http://www.dfg.ca.gov/habcon/nccp/publications.html).

At the state level, the 2007 MOU signed by the Secretaries of the California Environmental Protection Agency (Cal/EPA) and the California Natural Resources Agency (Resources Agency) establishes the Water Quality Monitoring Council. The Council now requires the boards, departments and offices within Cal/EPA and the Resources Agency to integrate and coordinate their water quality and related ecosystem monitoring, assessment, and reporting. The Monitoring Council is further aligning state aquatic resource monitoring programs with their federal counterparts in order to develop an integrated monitoring program that addresses the needs of the HCP/NCCPs while providing CWA monitoring data and information that will satisfy the Corps of Engineers, EPA, and the Water Boards.

The primary goal of such a program is to develop a fully integrated monitoring framework (covering ESA, CESA, CWA, and the Porter-Cologne Act) that provides the best available information on the extent of impacts from permitted activities and progress toward achieving conservation targets using common databases to facilitate the sharing of this information across eco-regions and among local, regional, state and federal programs.

The monitoring design for this comprehensive federal/State monitoring program is based on the EPA tiered monitoring approach (http://water.epa.gov/type/wetlands/outreach/upload/techfram_pr.pdf), which has also been adopted by the State, is increasingly used by programs across the country, and is consistent with the tiered approach described by Atkinson et al. (2004)[34]. The Delta Science Plan (dated 12/30/2013 and found at http://deltacouncil.ca.gov/science-program/delta-science-plan) describes a process by which this monitoring approach could be developed and implemented, including sections on adaptive management, data management, modeling, and communication. EPA strongly supports the recommendations in the Delta Science Plan.

Recommendation: *Discuss how the BDCP mitigation monitoring and reporting program will be consistent with the federal and State efforts discussed above.*

[34] Ibid

8/27/2014 1:33pm

BDCP DEIS: Corrections and Additional Editorial Recommendations

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Will, Ryan –

Yesterday, I sent you EPA's major comments on the BDCP DEIS. During our review of the DEIS, we also identified a number of corrections that are needed, as well as some missing information that would improve the document's usefulness. These are listed below. In our role as a Cooperating Agency, we request that you also address the following in the Supplemental Draft EIS:

- Potential funding sources shown on page 8-105 of the BDCP are not valid. The table in the BDCP shows EPA's 2011 budget being spent on conservation measures under the BDCP. The text states that "Funding for this program [California Bay-Delta Restoration appropriations] is assumed to continue and to support natural community restoration under BDCP" (p.8-106 of the BDCP). EPA has not committed any funding towards the construction and implementation of the BDCP and any future funds that are available for projects in the San Francisco Bay Delta are subject to EPA's future budget, legislative mandates, and agency discretion. Please remove the section of the BDCP that indicates that EPA funding is assumed to continue and support restoration components of the BDCP for 50 years.

- There are errors in the Draft EIS describing multiple Clean Water Act programs including the CWA 404 Regulatory Program. In addition, the CWA Section 404 Program is described differently in different chapters. Please make the following corrections:

    - Correct language on page 8-114 that states that CWA Section 404 is implemented "via the issuance of National Pollutant Discharge Elimination System permits." The NPDES program comes from Section 402 of the CWA. The words "NPDES" permits should be replaced with "Section 404 permits." The following sentence in the Draft EIS accurately states that the "USACE is authorized to issue Section 404 permits."

    - Correct language on page 8-113 (lines 4-6) that states California "administers the CWA through the Porter-Cologne Act." Section 303 of the CWA gives the states the authority to establish water quality standards, subject to EPA approval, and the NPDES Program is delegated to the State of California under CWA Section. California administers these CWA programs **and** the Porter-Cologne Act.

    - The following sentence in the Draft EIS on page 8-114 is not correct and should be removed: "If a federal agency is a partner in the implementation of a project, the proposed action/project must be recognized as the LEDPA." A proposed action is not the LEDPA simply because a federal agency is a partner and chooses that proposed action as its preferred alternative. Federal agencies are required to comply with the 404(b)(1) Guidelines and their preferred alternative must meet the restrictions to discharge outlined at 40 CFR 230.10.

- Table 3-3 (p.3-19) "Summary of Proposed BDCP Conservation Measures of All Action Alternatives" is the only complete Conservation Measure (CM) summary table provided in the entire Draft EIS. While it is helpful to the extent that it lists all of the CMs in one place, it is lacks key information such as acreage

targets.

- CM2 is not included in the list of Conservation components for Alternative 1A on p. 3-49. The Draft EIS states that CM2 is included in all of the Alternatives considered.

- CM2 is not included in the description of CM3 Natural Communities Protection and Restoration (page 3-129).

- Table 8-1 Designated Beneficial Uses for Water Bodies in the Study Area identified Estuarine Habitat as an "Additional Beneficial Use of the Delta" suggesting the Delta is the only group of water bodies with the Estuarine Habitat beneficial use. The San Francisco Bay and its component water bodies, including Suisun Bay and Marsh also have the Estuarine Habitat beneficial use and they are part of the BDCP "Plan Area."

- The 2012 Pulse of the Delta was finalized in October 2012. Delete the word "draft" in reference to the *2012 Pulse of the Delta* on Page 8-48, line 39.

- Figure 8-7 shows the compliance locations commonly discussed in Chapter 8 with so many labeled locations that the reader cannot see their location precisely.

- It is very helpful to readers to provide citations when "available evidence" is referred to in the Draft EIS. For example, page 8-457, line 7, states "available evidence suggests that restorations activities establishing new tidal and non-tidal wetlands, new riparian and new seasonal floodplain habitat could potentially lead to new substantial sources of localize DOC loading within the Delta."

- Existing Conditions and No Action Alternative values are slightly different in Tables 11-1A-5 (p. 293) and 11-4-4 (page 1302). The tables rely on the same entrainment analysis at south Delta pumps, but one is for Alternative 1A and the other is for Alternative 4. The Existing Conditions and No Action Alternative numbers are very similar, but should be identical, and it is not clear why they are different. This occurs again for the North Bay Aqueduct Analysis (p. 11-295 Table 11-1A-7 v. page 11-4-6 page 11-1304).

- The list of local habitat conservation plans and natural community conservation plans in the Delta includes plans that are adjacent to the Delta is missing the south Sacramento HCP (page 11-176).

- Page 11-160: There is very little description of Section 10 and Section 7 of ESA. The Revised or Supplemental Draft EIS should include a description of basic regulatory requirements and targets that are applicable to the BDCP such as "contribute to recovery" for Section 10 and "avoid jeopardy" for Section 7.

- Page 11-166: CWA Section 303(c) Water Quality Standards and protection of beneficial uses should be discussed in this section.

- Page 11-175: The need for a change in point of diversion to D1641 should be discussed in this section.

- Page 11-183: Table 11-3, please discuss options for soft stabilization along river banks near the intake structures.

- Table ES-11 and its associated text describe changes in average Delta outflow, total exports, and south Delta pumping for the BDCP alternatives in the late long term (2060); however, the baseline for this comparison should be specified.

- The change in total exports from the No Action Alternative to Alternative 1 is listed in Table ES-11 as 1,025 thousand acre feet however, subtracting the value of No Action Alternative total exports (4441 TAF) from that of Alternative 1 total exports (5459 TAF) yields a difference of 1018 TAF. Similar small potential errors are present in the rest of the Total Exports Change column.

- The average Delta outflow and export values in Table ES-11 do not match average Delta outflow and export values in Table 5-4 Water Supply Summary Tables. Many of the values are very close to one another, but are not the same. The true values are important for determining compliance with Delta outflow water quality standards.

- Selenium effects and thresholds vary between the EIS and the appendices (see p. 8-167 (table 8-55) and page 8M-9 (table 8M-3)).

- Language used to describe Total Maximum Daily Loads in the Plan Area and Study area for Chapter 8 could be misinterpreted. Table 8-4 and the text in lines 13-15 on page 8-24 state that a number of TMDLs are "complete", which could be read as suggesting that TMDL water quality targets have been achieved, which is not accurate for most TMDLs. Many of these TMDLs are *adopted* and water quality is improving as a result, but is not yet meeting the TMDL quantitative targets. Replace the word "complete" with "adopted" in reference to TMDLs in this section.

- Table 22-5 should be updated to identify the annual PM2.5 NAAQS as 12 micrograms per meter cubed ($\mu g/m^3$).

- Table 22-3 provides ambient air quality monitoring data, in terms of standards exceedances, for the relevant air basins from 2008 to 2010. This table should be updated to provide monitoring data from 2010 to 2012.

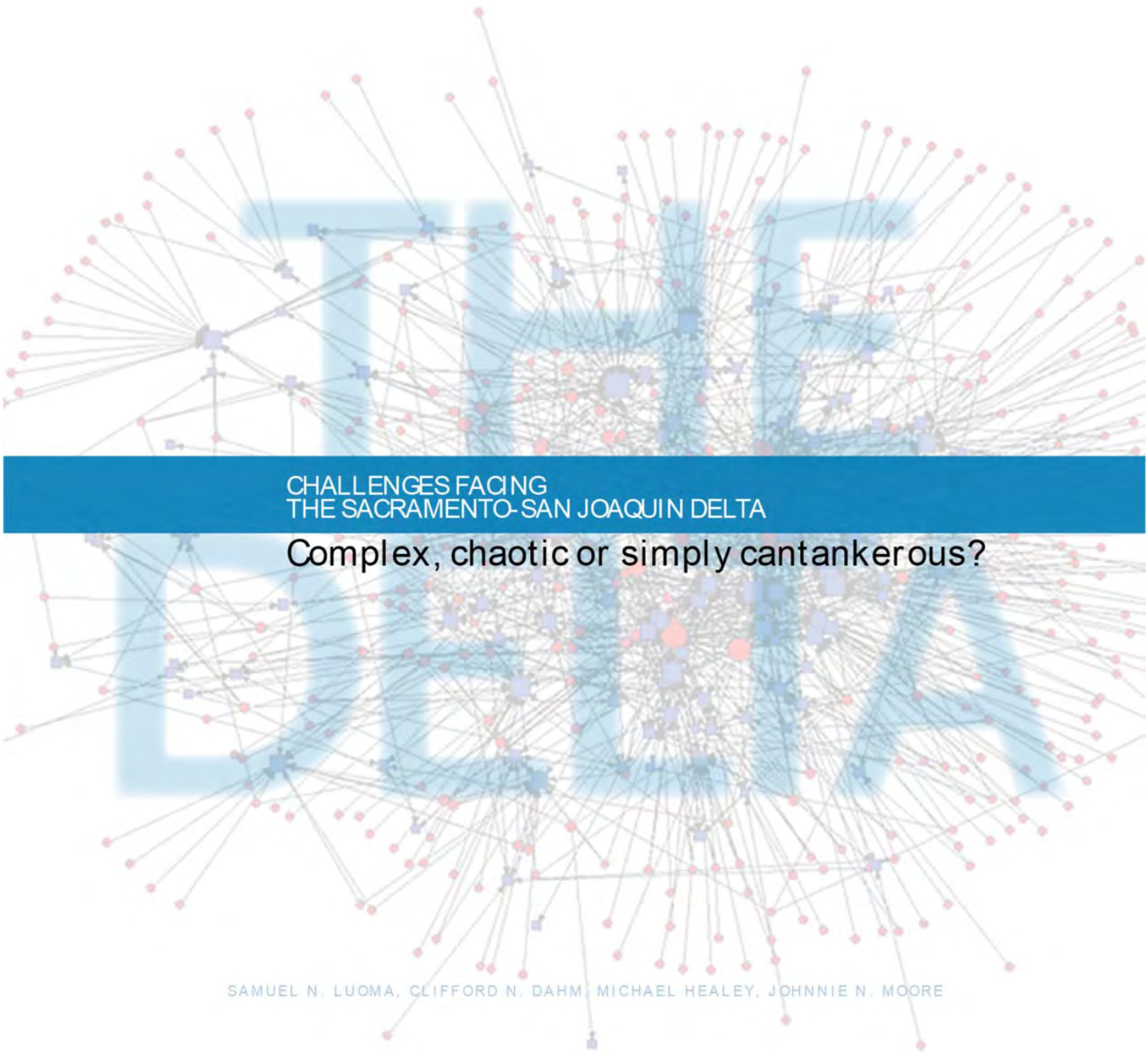
- The data used to describe organophosphate pesticides on page 8-85, Tables 8-23 and 8-24 do not characterize existing conditions. More recent data show that diazinon is rarely detected in Delta waters in recent years and chlorpyrifos detections and exceedences have substantially declined. Update the pesticide discussion using more recent data. These data are available at http://www.ceden.org.

- In Table 30-2, it is unclear how much of the environmental water is also used by agriculture and urban users. Separate tables by water year type would be more informative.

Thank you for your consideration of these recommendations. If you have any questions, please contact me.

-Kathy

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CHALLENGES FACING THE SACRAMENTO-SAN JOAQUIN DELTA

Complex, chaotic or simply cantankerous?

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A number of elements were added to this public information brochure that were not part of the SFEWS journal article including: the cover; the executive summary; all photos except those in Figure 2; text excerpts and pull quotes on pp. 3, 7, 12, 25 & 29.

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Challenges Facing The Sacramento-San Joaquin Delta: Complex, Chaotic, or Simply Cantankerous?

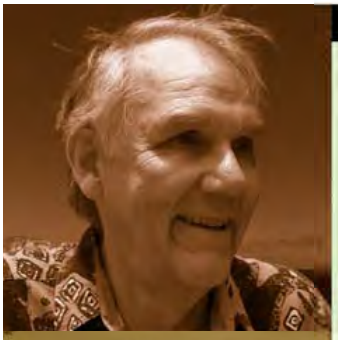
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Photo: Rick Lewis

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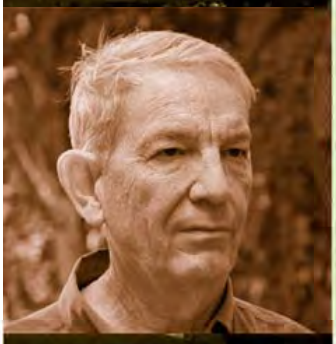
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Cliff Dahm, as the fourth Lead Scientist, took the reins in July 2008 during a time of fiscal crises, staff furloughs, and stop-research orders. He led the program through the passage of the Delta Reform Act of 2009 that created the DSC, established the Delta Science Program (DSP), and enabled the Delta Independent Science Board. He also guided the DSP during the initial development of the Delta Plan. Dahm left in early 2012 and returned as interim lead scientist in fall 2015.



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Mike Healey, the third Lead Scientist, was science advisor to the Delta Vision Blue Ribbon Task Force, which laid the foundation for the legislation that created the Delta Stewardship Council. Healey served in 2007 and 2008, until Dahm took over. Healey was the editor in chief of the first issue of *State of Bay Delta Science, 2008*.



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EXECUTIVE SUMMARY



"In these times of uncertainty it is important to be nimble, be timely and be prepared in our decisions and our implementation. We cannot afford to shy away from bold actions but we must broaden the de□nition of "bold" to include more than engineering: conservation alternatives, the environment and governance must be a part of every decision."

— SAMUEL N. LUOMA

Executive Summary

In 2014, the California Natural Resources Agency and the U.S. Department of the Interior asked the authors of this paper, as four former leaders of The Delta Science Program, to summarize the challenges faced by water supply and ecological resource managers in this critically important region of Northern California. They concluded that the challenges are so complex as to meet the de nition of a "wicked" problem. Such problems can't be ignored, defy straightforward characterization, and have no simple solutions. Yet they must be actively managed to maximize bene cial and minimize adverse outcomes.



Several runs of Chinook salmon in the Sacramento River are endangered or listed (juveniles pictured here).
Photo: Roger Tabor, USFWS.

In California, water supply and demand are increasingly out of balance. At the same time, the very cornerstones of the water supply system are changing. Snowpack is declining with warming temperatures, groundwater is being pumped at an unsustainable rate, water infrastructure is aging, and human demand for water continues to grow. Meanwhile, many native species and ecological systems in the Delta are on the point of collapse. Add the uncertainties of drought and ood and a 60% chance of a signi cant earthquake by 2050 resulting in cascading levee failures, and the need for a new approach is urgent. Repeated management crises suggest that the status quo is unsustainable. Water managers no longer have the exibility they once had in dealing with the multi-year droughts that are inherent to the California climate. Furthermore, management initiatives are often delayed by the multiplicity of agencies and actors involved and by litigation. Managing the water supply system alone is complicated. But add in the imperative to sustain the ecological and social values of the Delta and every decision becomes unimaginably complex.

In this context, the following paper calls for Delta management to become more nimble and better coordinated. The situation requires bold, timely, and well-considered actions, taken incrementally (in stages) where possible, with the understanding that any management action typically leads to new complexities that must also be managed. With water scarcity has come the awareness that problems are less amenable to traditional engineering solutions, and that attempts at dramatic, simple solutions may intensify the risk of unexpected, if not catastrophic, consequences. Simultaneous attention to a portfolio that includes actions like addressing overuse and mis-use of water, and improving ground water management and storage, should accompany any necessary water infrastructure adjustments. Renewed emphasis on reducing known stressors, restoring native ecosystems, learning from our actions, and managing collaboratively and adaptively is essential if native species are to be retained. Comprehensive modeling that takes account of the many dimensions of the Delta problem should provide a foundation for determining the best approaches to implementing restoration and water management initiatives and forecasting the degree to which they will be effective.

Thanks to the public's long-term investment in good science, the Delta is one of the most intensively studied systems in the world. Managers have information to work with, although important questions remain unsettled. Throughout decades of con ict over water issues, all parties have agreed that advancing the state of scienti c knowledge is fundamental to making constructive progress. As we enter an era of increasing uncertainty about climate and water supply, science conducted in collaboration among multiple institutions must be brought to bear and decisions must transcend individual agency directives or the needs of special interests.

Forecasting the future of complex problems like the Delta will require scienti c models that can simulate the consequences of different management approaches. Such models have been developed for water operations; are in their early stages for the ecosystem (DiGennaro et al. 2012) and climate change (Cloern et al. 2011); and have been used to envision alternative futures for the Bay-Delta (e.g., Lund et al. 2010).

WHAT IS THE DELTA?

The Delta is where the Sacramento and San Joaquin rivers ow out of the mountains and onto valley oodplains, spreading out onto a 3,000-square-kilometer landscape of islands and shallow waterways before owing into the San Francisco Bay. Before it was diked, drained, and developed, the Delta was a vast wetland complex of low islands, shifting channels, woody debris piles, and tule marshes. Today, the Delta is a patchwork of largely agricultural islands separated by deep channels and protected by 1,100 miles of aging levees. It hosts farms, sheries, water projects, recreational areas, and the state capitol in Sacramento. Geographically, it is the largest delta on the Paci c coast and encompasses an area almost the size of Rhode Island.

The Delta is

- One of the largest waterworks in the world. This critical hub of a regional water redistribution system is a complex network of dams, pumps, canals, drains and reservoirs, all of which are managed jointly by local, state and federal institutions to meet goals of ood control, water supply, and environmental conservation.
- A real place where people live and play, with a rich cultural history. More than 570,000 people live in the greater Delta, mostly in the urbanizing regions around the margin of the Delta. Many of them derive their livelihoods directly from the Delta. Most of the rest use the Delta for transportation, recreation, and as a source of water.



- The heart of California's agricultural economy, which produces more food than any other state with $45 billion in sales per year. Because California produces most of the fruits and nuts and a high percentage of vegetables consumed in the US, restrictions on water for agriculture in the greater Delta affect the availability and price of these agricultural products throughout the US and elsewhere. If production relocates because of water shortages in California, some of the con icts over water will also relocate.



- Home to more than 750 species of plants and animals. The California Floristic Province, of which the Delta is a part, is one of 25 hotspots of biodiversity across the world cited as highest priority areas for conservation of species (Myers et al. 2000). Some species are present year round, like Delta smelt, Sacramento splittail, salt marsh harvest mouse, and soft bird's beak. Other species are important culturally or economically, including salmon, sturgeon, and migratory waterfowl and shorebirds. The presence of migratory species connects the Delta to ecosystems far to the north, south, and west just as the existence of the water distribution system connects the Delta to regions far to the south and east. The Delta is truly an internationally connected ecosystem with contributions to local and state enterprise, to regionally valuable sheries, and to global biodiversity.

Photos, this page: Birds Eye View

Challenges remain in merging models of various types and in ensuring the models are reliable and address issues at the geographic and temporal scales appropriate for management. If carefully implemented and interpreted, such models would provide valuable guidance and a foundation for both coordination and evaluation of management initiatives.

Water scarcity has de ned and will continue to de ne the future of the Delta and all that is linked to it. California has risen to the challenge of water scarcity in the past to build an economy and a society that is, in many ways, the envy of the world. Accepting water scarcity raises economic, ecological, water infrastructure and organizational complexities in the Delta to a new level, well beyond traditional approaches that consider water supply solutions in isolation. Nevertheless, California has the tools and the intellectual resources to manage the multiple dimensions of the problem and thereby achieve the state's twin goals of a reliable water supply and an ecologically diverse Delta ecosystem.

DELTA CHALLENGES

- **California's water supply is over-allocated.** State water rights allocate more than 500% of average annual river ows (Grantham and Viers 2014). The current drought, climate change, and normal year-to-year variability in precipitation are increasing uncertainty in water supply.



Photo: Chris Austin

- **California's vast water management infrastructure is decaying** and overtaxed. This increases the risk of catastrophe.
- **Delta water availability uncertainties will have consequences throughout seven western states and into Mexico,** due to California's participation in the Colorado River Basin Compact. Although the California economy has proved resilient to year-to-year water shortages in the past (Hanak et al. 2012), negative consequences of a more permanent water scarcity will be increasingly dif cult to avoid (Howitt et al. 2014) and will carry over to the economies of the region, the nation, and the world.
- **Native ecosystems and species are declining.** Multiple interacting factors affect their well-being, only some of which are well understood. Predicting the outcome of changes to water operations, landscapes, or levees is uncertain, at best.



Photo: NOAA

- **Upgrading levees to address growing risks will be costly** (risks include earthquakes, storms, rising sea level). Not all levees are xable, sustainable, or defensible in perpetuity. Failure of levees in one part of the Delta, however, increases the risk of failure elsewhere. Multiple, simultaneous levee breaks would allow a massive salinity intrusion into the Delta. Turning the Delta brackish would threaten agricultural crops and urban water supplies that rely on high-quality water exported from the area.



Photo: Birds Eye View

- **Water quality is threatened by the complex spectrum of chemicals entering the Delta.** Sources include agricultural runoff, industries, wastewater treatment plants, urban stormwater discharges, and atmospheric fallout. Chemicals interact with physical conditions in the Delta, and with other stressors in the system, in a dizzying number of ways, making risks to water supply and native organisms dif cult to assess.
- **Delta management is unusually complex.** More than 230 agencies, institutions and stakeholders are involved. Each plays a useful role. However, a number of these entities have very different core interests, con icting visions, and competing priorities. The result: institutional fragmentation that slows decision-making and confounds collaborative management.

INTRODUCTION



Thermalito Afterbay, part of the State Water Project system downstream of Oroville Dam.
Photo: Matt Elyash, CDFW

If the problem were just about allocating freshwater □ows, it might be solvable. Add in the complexity of moving water through a hydrologically and hydro-dynamically complex Delta and it becomes complicated. Add the uncertainty of ecological responses and the institutional complexity of many actors with many visions and the problem becomes wicked. Then add the ever-changing water supply and ecological and economic contexts within which decisions must be made, and the problem becomes devilishly wicked.

Introduction

California, the most prosperous state in the nation, has an economy and a lifestyle built on water—and an illusion that freshwater is always abundant. However, the current drought, now entering its fourth year, has brought sharply into focus the fact that water is a scarce resource. With snowpack in the Sierras at a record low, Governor Jerry Brown has decreed serious water rationing, stating: "This is the new normal and we'll have to learn to cope with it." (KTLA 5 News 2015).

Shortages of water and con icts over water use are nothing new in California. The Delta of the Sacramento and San Joaquin rivers (the Delta; Fig. 1) is at the center of these con icts. Major state and federal water projects began delivering water from the Delta in 1949 to agricultural and urban users in the San Joaquin Valley and southern California. This redistribution of water stimulated economic growth, but the projects were soon plagued by con ict over whether, when, and how to transfer water from the Delta (Hanneman and Dyckman 2009). Con ict intensi ed with the listing under the federal and state endangered species acts of more than 50 native species found in the Delta (DSP 2013). As public concern grew, new policies were put in place to address environmental effects. These initiatives also led to improved understanding of the Delta, the listed species, and the complexities of managing the Delta to achieve a reliable water supply and a healthy ecosystem. Nevertheless, listed species continue to decline and dissatisfaction with water deliveries continues to grow. There is concern that the present approach to water operations is unsustainable in the face of widening demands[1] and shrinking supplies. Frustration with management's inability to satisfy all the demands for water has led to litigation, distrust among parties, and the threat of policy paralysis, with cascading consequences for California, the semi-arid west and the nation (see Delta Con icts at left).

In this paper we look at multifaceted questions about water and environmental management in the Delta. Our goal is not to evaluate speci c recent initiatives, but to provide a larger framework to guide implementation of these and future initiatives. We illustrate how the complexity of the Delta problem complicates management and leads to inef ciency and con ict. We give examples of trade-offs, disagree-



Shasta Dam. Photo: USBR

DELTA CONFLICTS: CASCADING CONSEQUENCES

- Federal and State regulations curtail water exports from the Delta when legally protected species, like salmon and Delta smelt, are drawn into the pumps.
- Local restrictions on exporting water from the Delta impact the intricately balanced supply and demand of interdependent water transport networks throughout California and the Colorado River Basin.
- The Colorado River Basin Compact is a complicated deal that de nes water rights of users in the seven states that share the river. Southern California obtains water from both the Delta and the Colorado River Basin. California's supply of Colorado River water was reduced with implementation of the Compact. Reducing supplies to Southern California from the Delta increases their reliance (within the bounds of the agreement) on water from places like Lake Mead in the Colorado River system (Fleck 2012). Integration of interstate water infrastructure via these complicated agreements means that decisions about water exports from the Delta have cascading consequences for ows in the Colorado River, as well as endangered species conservation and water supply disputes throughout the Colorado River Basin.
- With so much at stake, it is not surprising that water managers argue that water disputes throughout the arid and semi-arid western US cannot be resolved in the absence of decisions about managing the Delta (Austin 2015; Fleck 2012).

ments and the consequences of failure in managing these issues. We discuss why bold new approaches to managing Delta issues are urgently needed to address inefficiencies in water use, aging infrastructure, and the deteriorating condition of native species. We also show that it is important to ensure that those actions take full advantage of existing knowledge, are implemented incrementally where possible, and are accompanied by ongoing evaluations of outcomes and subsequent adjustments, as necessary. Our hope is that this paper will help managers and policy-makers better appreciate the complexity of water and environmental management in the Delta, and understand that there are ways to move forward.

The Problem

At its simplest, the problem of the Delta is similar to water challenges throughout the arid and semi-arid western U.S.: growing demands and over-allocated resources. For example, California has water rights that allocate over 500% of average annual river flows (Grantham and Viers 2014). Media reports often focus on the conflict over whether water should be exported from the Delta or left flowing through the Delta to San Francisco Bay to sustain listed native fish species. All this attention to flows and fish creates the impression that if only water managers in the major river basins would "get their act together," the problem could be solved. But the problem of the Delta is more complex than a simple decision about allocating flows. It is a problem with many different dimensions (Table 1) and interactions that confound simple answers.

Historically, the problem of water management was about supply: not enough

TABLE 1. The Delta Problem:
A nationally important but "wicked" problem with many dimensions and potentially contradicting solutions.

Dimension	Problem	Some Characteristics
Physical	Natural system seasonal and episodic	Strong seasonality of water supply; highly variable year-to-year; drought and floods the norm; changing climate; high earthquake damage potential.
Socio-Economic	Unsupportable demand from population, economy	Growth nearing limits of water supply; inadequate awareness that water is scarce; directly linked to the rest of the semi-arid West.
Water Supply	Increasingly vulnerable water infrastructure	Aging conveyance and levee systems stretched to limits; snowpack declining; groundwater exploited at an unsustainable rate; water used is out of balance and inadequately tracked.
Environment	Multiple stresses on ecosystem	Many native species at risk; scale of change massive, difficult or impossible to reverse; stresses difficult to manage, may act in combination, can change over space and time.
Ecosystem Restoration	Difficulty ensuring project success	Some projects help native species while others attract invasive species; benefits of water diversion mitigations questionable; successes, failures, and challenges inadequately tracked.
Institutional	Insufficiently unified vision for the Delta	Plethora of institutions with their own visions and contradicting missions; monitoring programs plentiful yet uncoordinated; management programs inconsistently coordinated and evaluated.
Science	Key uncertainties remain	Multi-institutional, collaborative approach requires new support; equal need for broadly applied science and research focused on immediate policy issues; data sharing must be improved.
Management	Contradictions among solutions	Problems can be characterized in many possible ways; single-focus problem solving can create unanticipated outcomes; management must be continual and adaptable.

THE DELTA: A WICKED PROBLEM

- If the problem were just about allocating ows, it might be solvable.
- Add in the complexity of moving water through a hydrologically and hydrodynamically complex Delta and it becomes complicated.
- Add the uncertainty of ecological responses and the institutional complexity of many actors with many visions and the problem becomes wicked (Dryzek et al. 2013).
- Then add the ever-changing water supply and ecological and economic contexts within which decisions must be made, and the problem becomes devilishly wicked.

water in the south and more abundant water in the north. California's impressive water system was designed to address this supply problem. But California's water problems can no longer be solved through supply management and traditional engineering solutions alone. Water supply and demand are increasingly out of balance, and the cornerstones of the water supply system are changing. Snowpack is declining with warming temperatures, groundwater is being mined at an unsustainable rate, the infrastructure is aging, human demand for water continues to grow and the Delta ecosystem continues to deteriorate. The accelerating pace of these changes introduces a new urgency into the need to nd novel ways to manage the host of variables that affect water and the Delta ecosystem.

Human use of the Delta and surrounding lands has changed the landscape and water quality in ways that create serious environmental challenges (Fig. 2). We know that multiple factors (e.g., water ows, water quality, invasive species, predation pressure, and habitat loss) interact to increase risks to native species. Despite measures to address individual stresses, the situation for many native species is increasingly dire (Sommer et al. 2007). Largely because of massive landscape transformations, the Delta cannot be restored to what it once was (NRC 2012). But the situation for native species can be improved, and there is a new urgency in taking advantage of whatever opportunities exist to do that. Exactly how to reduce the cumulative impacts of the stresses on the ecosystem is not clear (Baxter et al. 2010), but the need to address this multiplicity of problems and their interactions is as urgent as the need to address water-supply issues.

Another aspect of the problem is that more than 230 agencies, institutions and stakeholders claim a role in water and environmental management but come with different core interests — and often con- icting visions of how the Delta should be managed. The resulting institutional fragmentation creates con ict and slows decisions. Addressing the water supply and ecosystem problems of the Delta will require management institutions that are both nimble and suf ciently coordinated to take bold, timely and well considered actions.

Formally, the problem of water and environmental management in the Delta ts the de nition of a "wicked" problem in the sense of Rittel and Webber (1973; see The Delta: A Wicked Problem above). Recognition of the Delta as a wicked problem presents a new way to think about management. Wicked problems have no single correct



Fresh water from the Delta system supplies both irrigation water for farms and drinking water to cities as far away as Los Angeles. Delta waters also sustain sh and wildlife and recreational activities. Photos: NeilArmstrong2 (left); Bird's Eye View (center and right).

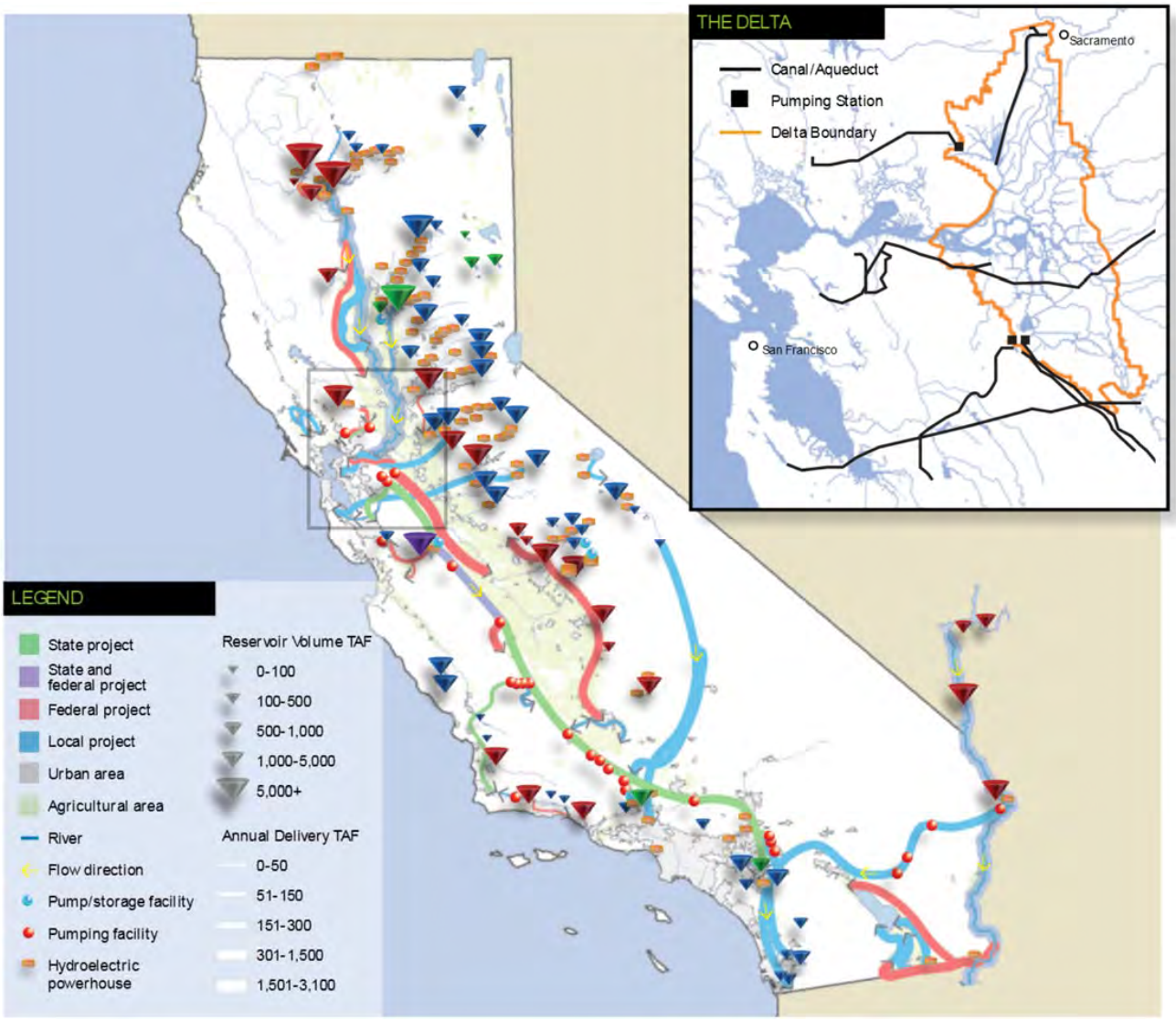


FIGURE 1. Water supply system in California (large map) showing reservoirs and canals storing and transporting water from the wetter northern areas of the state to the drier southern and coastal areas. The Delta (inset) is at the heart of the system, pumping water to the south from two large pumping plants in the southern Delta. Reservoir volume and annual delivery is in millions of acre feet. Within the Delta, di-erent zones are dominated by di-erent uses and economic productivity. Agriculture is the most important economic activity in the Delta's economy producing $800 million annually in crops (e.g., corn, alfalfa, tomatoes, wheat, and wine grapes). Adding all value-added activities (wineries, dairies, canneries, etc.), the Delta produces $2.6 billion in total economic output and 13,000 jobs for the counties encompassing the Delta and $5.3 billion and 25,000 jobs statewide. Recreation is the second most important economic activity in the Delta, generating $312 million and over 3000 jobs annually within delta counties, and over 5300 jobs and $353 million statewide. Natural gas from the Delta also produces more than 20% of California's gas-powered electricity (DPC 2012).

characterization and no single correct solution, only better or worse approaches to management of the situation. This means the Delta's problems cannot be solved in the traditional sense, but they can be actively managed to minimize adverse outcomes and maximize bene cial outcomes (Healey 2008). Dif cult political decisions and bold actions will be necessary, and this will require thinking outside the box, thinking holistically, making learning integral with doing, and nally and honestly embracing the equivalent value of water supply and ecological health. Addressing demand will be as important as addressing supply; restoring ecological function (as Moyle et al. [2012] suggest) will receive as much attention as re-engineering water-distribution infrastructure; and broadly coordinated actions will take precedence over individual institutional missions. The Delta Stewardship Council, the Delta Reform Act, and the Delta Plan provide an institutional and policy framework for this kind of operational innovation.

Why is the Delta Problem Important?

As the hub of a regional water-redistribution system, the Delta is a critical node in a complex network of dams, pumps, canals, drains and reservoirs, all of which are managed jointly by local, state and federal institutions to meet goals for ood control, water supply, and environmental conservation (Fig. 1). This engineering marvel is one of the largest waterworks in the world. Through California's participation in the Colorado River Basin Compact, uncertainties about water availability from the Delta have consequences throughout seven western states and into Mexico.

Water is a fundamental driver of the economy of the western US. California's economy is the most productive in the country (Fig. 2; see Economy Underpinned below). The water system is the lifeblood of this economic powerhouse and fuels the nation's most productive agricultural sector. The Delta contributes to the California economy in myriad other ways. Commercial shipping moves through the Delta to and from the ports of Stock-

THE INTERNATIONAL, NATIONAL AND STATE-WIDE IMPORTANCE OF AN ECONOMY UNDERPINNED BY AVAILABILITY OF WATER FROM THE CALIFORNIA DELTA

- A gross domestic product of $2.2 trillion.
- The 8th largest economy in the world, equal to Brazil's.
- Contributes 13% to the total economic output of the United States.
- Ranks 1st in the nation for patents.
- Outpaces all other states in venture capital investment with 41% of all companies in the U.S. receiving venture capital from California.
- Has the highest rate of employment by U.S. subsidiaries of foreign companies.
- Exports $174 billion of products annually ($48 billion from computer and electronics goods) for 11% of total U.S. exports.
- Imports more than $230 billion in goods from other states and countries.
- Entertainment industry in California accrues over $47 billion per year.
- California produces more food than any of the 50 states with $45 billion in sales per year, including:
  - 40% of annual national agricultural production; 45% of all the fruits and vegetables, including:
    - 98-99% of U.S. almonds, walnuts and pistachios.
    - 90-95% of broccoli, strawberries, grapes, and tomatoes.
    - 74% of all lettuce.
    - Produces many crops year round supplying the nation with fresh produce throughout the winter.
- Because California produces most of the fruits and nuts and a high percentage of vegetables consumed in the US, restrictions on water for agriculture in the greater Delta affect the availability and price of these agricultural products throughout the US and elsewhere.
- If production relocates because of water shortages in California, some of the con icts over water will also relocate.

References in footnote 3, p. 30.

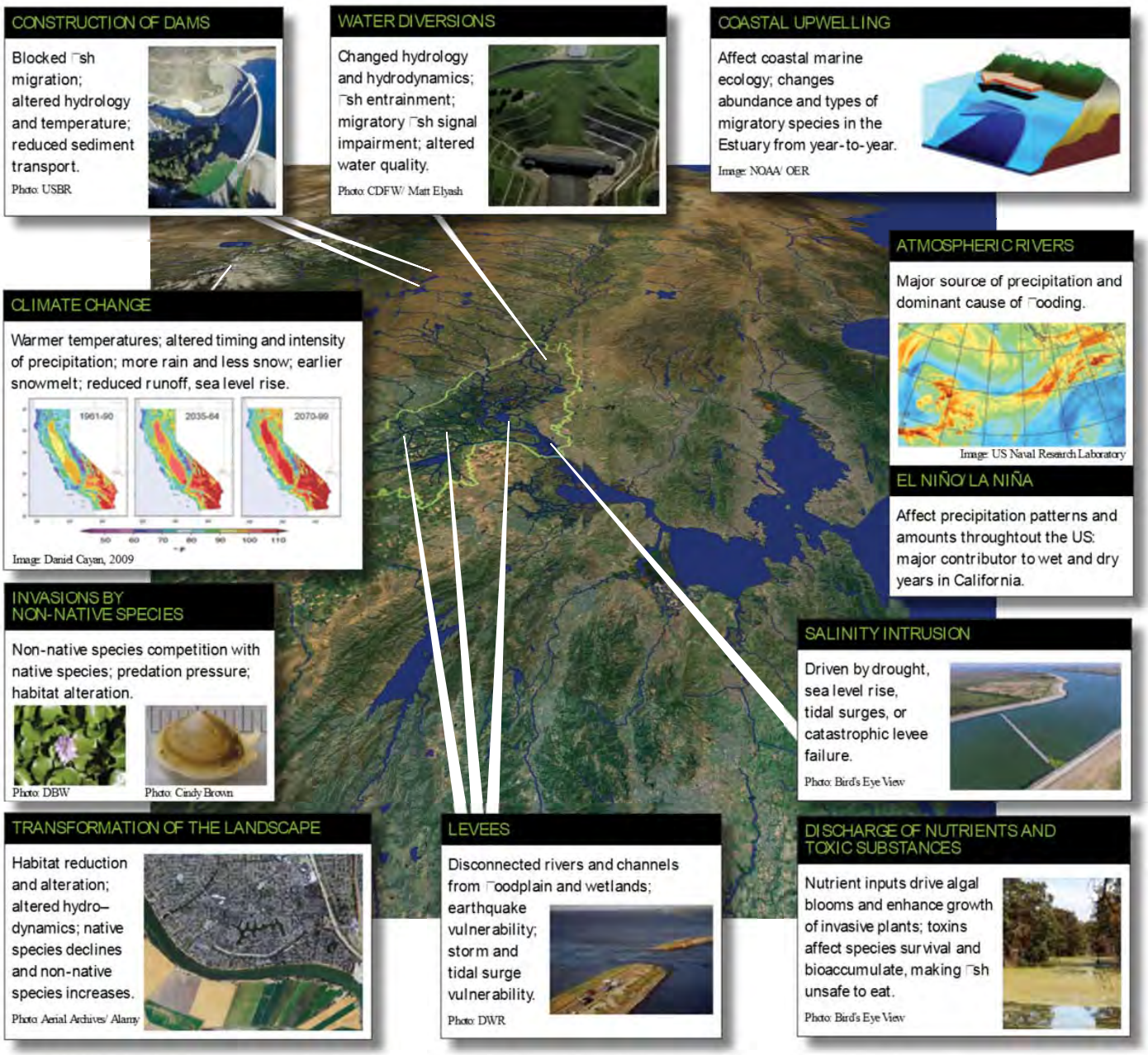


FIGURE 2. The Delta ecosystem responds to factors both within the physical Delta and from regional stressors and drivers of change, including the ocean. Eleven major factors a-ecting the current Delta are highlighted in this regional view of the Delta and surrounding landscapes. Aerial photo research: Amber Manfree.

ton and Sacramento, and several major rail lines cross the Delta. Natural gas is generated and stored in the Delta. Silicon Valley, the heart of America's electronics industry, gets half its water directly from the Delta. California's entertainment industry — America's largest export — is also centered in cities dependent upon Delta water (Farhi and Rosenfeld 1998). Although the California economy has proved resilient to year-to-year water shortages in the past (Hanak et al. 2012), negative consequences of a more permanent water scarcity will be increasingly difficult to avoid (Howitt et al. 2014) and will carry over to the economies of the region, the nation, and the world.

The Delta is also of considerable ecological importance. With San Francisco Bay, it is home to more than 750 species of plants and animals. The California Floristic Province, of which the Delta and Bay are a part, is one of 25 hot spots of biodiversity across the world cited as highest-priority areas for conservation of species (Myers et al. 2000). Some species are present year-round, like Delta smelt, Sacramento splittail, salt marsh harvest mouse, and soft bird's beak. Other species that are important culturally or economically, including salmon and sturgeon, utilize the Bay and Delta seasonally. Migratory waterfowl and shorebirds use the Bay and Delta as a feeding and nursery habitat during only a brief part of their lives, but these species could not exist without these systems. The presence of migratory species connects the Delta to ecosystems as distant as Alaska, the Pacific Ocean and South America, just as the water distribution system connects the Delta to regions far to the south and east. The Delta is truly an internationally connected ecosystem with contributions to local and state enterprise, to regionally valuable fisheries, and to global biodiversity.

Finally, the concept of the Delta as a place, enshrined in the 2009 Delta Reform Act, makes tangible the human dimension of issues such as water export and management, environmental management, and habitat restoration. All these activities go on in a real place, a place where people live and play, a place with a rich cultural history. More than 570,000 people live in the greater Delta itself, mostly in the urbanizing regions around the margin of the Delta (Secondary Zone, Fig. 1). Many derive their livelihoods directly from the Delta. Most of the rest use the Delta for transportation, recreation, and as a source of water. The importance of this social dimension of the Delta is a critical consideration in every decision that affects the fate of the region.



Sandhill cranes, listed species in California. Photo: Rick Lewis

The Delta, a Study in Complexity

Physical System Complexity

The Delta began forming about 10,000 years ago when rising sea level slowed the out ow of the Sacramento and San Joaquin rivers through Carquinez Strait. Sediments accumulated east of the strait and created a complex of low islands, shifting channels, large woody debris, and tule marshes (Whipple et al. 2012) that bedeviled early settlers but were the natural habitat of many species now in trouble.

Human activity has transformed the original complex wetlands and river oodplains into a 3,000 square km patchwork of approximately 57 islands separated by 1,100 km of sloughs and winding waterways (CDWR 2015). It is the largest delta on the Paci c coast of North America (almost the size of the state of Rhode Island). The islands of the central Delta are used primarily for agriculture, although there is a small amount of residential property. Only remnants of the original marsh remain, and many of these are highly managed (Ferner 2012).

The physical character of the Delta is at the center of some of the most complex and contentious aspects of the Delta problem. The islands of the Delta are protected by 1,800 km of levees (Fig. 3). The levees are aging and at risk of failures from numerous causes. In the 1990s, 160 levee breaches occurred, and breaches continue at a high rate (Bates and Lund 2013). Delta islands have subsided, particularly in the center and western portion of the Delta where the surfaces of many islands are now ve meters or more below sea level (Moore and Shlemon 2008), increasing the risk of levee failure. Droughts and oods also increase the risk of levee failure, and this risk will likely increase as these events become more frequent and more severe with climate change. Rising sea level, another consequence of climate change, further increases the risk of levee failure. Finally, the levee system is highly vulnerable to earthquakes. There is an estimated 60% probability that an earthquake of magnitude 6.5 or greater will occur in or near the Delta sometime in the next 35 years (Moore and Shlemon 2008). Levee maintenance is costly and upgrading levees to address the growing risks is costlier still. Ultimately, prioritization of maintenance and land uses will be necessary, and incremental approaches to this have been proposed (DSC 2015). But the levee system is also interconnected, making solutions more complex. Breaks or intentional breaches in one levee could increase the risk of levee failure elsewhere in the Delta. If any of these risks results in multiple, simultaneous levee breaks, there would be cascading consequences for water transit, water exports, local economics, and use of islands to bene t the ecosystem.



Remote sensing photography of Delta levee vulnerability from a joint NASA, DWR & CalTech project.

A most important consideration in the discussion of levee maintenance is that the levees are an essential part of the California water-distribution system. Delta channels are designed, in part, to channel Sacramento River water from the north Delta to the south Delta, where it is exported via massive pumps to the Central Valley and southern California (Fig. 1). This makes the levees critical to all the human uses of Delta water. One of the greatest concerns of Delta water managers is that multiple levee failures would allow a massive salinity intrusion that would threaten the many agricultural crops and urban water supplies that rely on high-quality water exported from the Delta. Desalini-

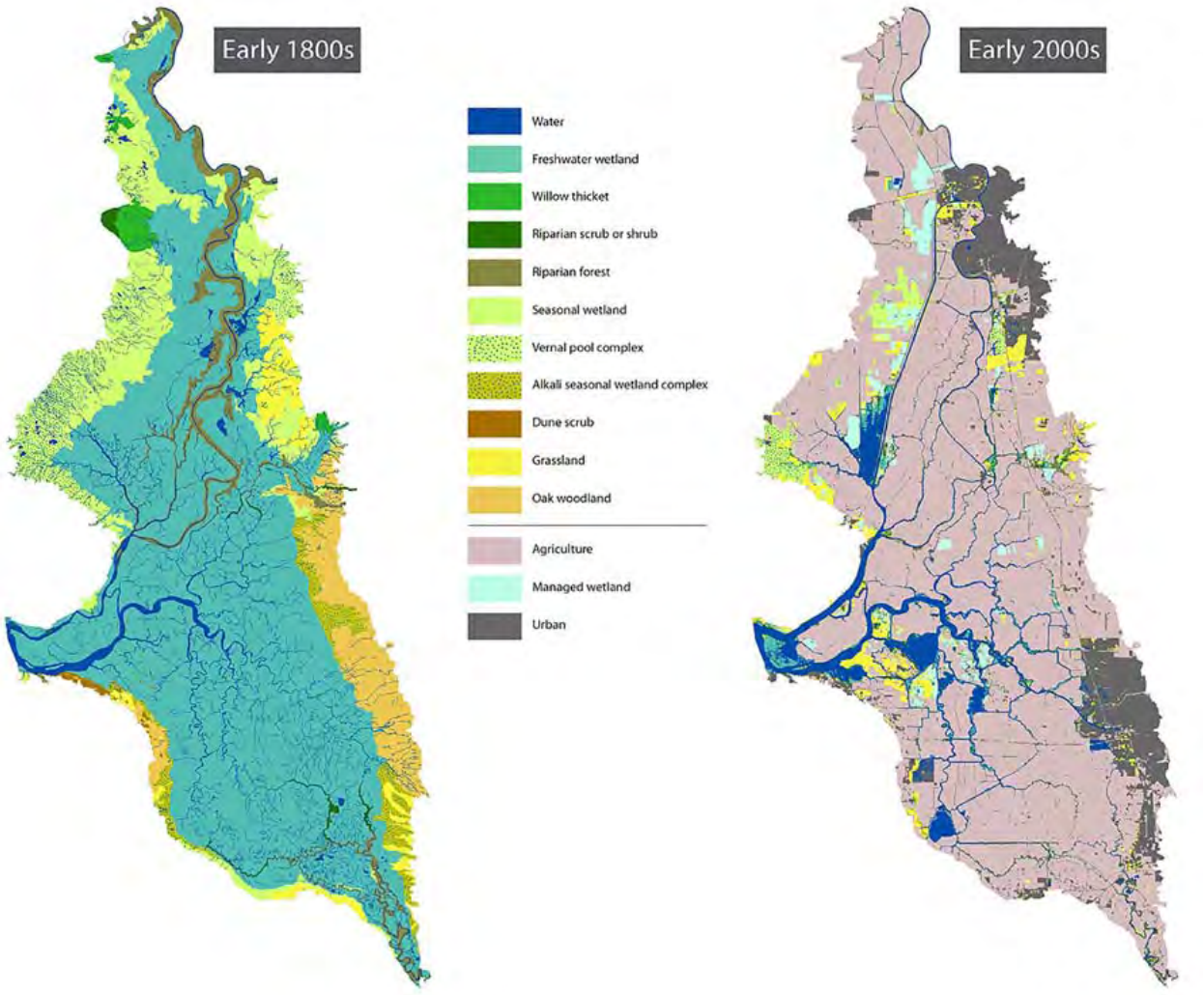


FIGURE 3. Maps of the Delta showing the transformation from a complex system of river and distributary channels of multiple sizes and shapes to the present water transport system dominated by straightened and simpliÅed channels. Transformation also included a major simpliÅcation of native landscape types to an agriculturally dominated landscape. From the Sacramento-San Joaquin Delta Historical Ecology Study, available at: www.sfei.org/ DeltaHEStudy (Whipple et al. 2012)

zation is not economically feasible to remove salt from irrigation water because of the volumes (and thus cost) involved. Water treatment facilities can remove salt from drinking water, but at a considerable increase to the cost of drinking water. In addition, there is a potential risk to human health from carcinogens that form during water treatment when the source water contains higher levels of organic matter and bromide (Richardson and Postigo 2012).

Under the current levee configuration, river flows out of the Delta provide a flow barrier that prevents intrusion of seawater from San Francisco Bay. If river flows drop too low, circulation driven by the tides (the strongest hydrodynamic force in the Delta) can carry salt, dissolved organic materials, bromide, and other chemicals to the water supply diversion points in the Delta. Reservoir releases are crucial in maintaining river flows in summer and fall when rainfall is limited. Thus, exports of high-quality water from the Delta depend upon a complex interaction among climate, reservoir operations, and levee configurations. For example, during prolonged droughts, there is increased risk that reservoir supplies will not be sufficient to maintain the flows that keep salinity away from the interior Delta. At the present time, after four years of drought, reservoir supplies are shrinking, the flow barrier is weakening, and water managers are adjusting levee configurations, each with their own problems, to ensure the quality of freshwater delivered from the Delta (Rubissow-Okamoto 2014).

Water Supply Complexity

The complexity of Delta water issues partly revolves around widening demand for water from a supply that is not only limited but also highly variable and growing increasingly uncertain. California's water supply is based upon four pillars: surface water, snowpack, groundwater, and the massive human-built infrastructure that stores and redistributes water from these sources. The human-built system is effective in managing seasonal variability and regional redistribution of water. Large storms that occur in late fall, winter, and early spring are a major source of California's water supply, contributing 30% to 45% of all precipitation in central and northern California (Dettinger et al. 2011). These storms are associated with atmospheric rivers, bands of warm, moist air from the subtropics that sweep across the Pacific and make landfall as a series of high-intensity rainstorms (with snow in the high mountains). These intense storms are a mixed blessing, sometimes providing much-needed water and at other times causing significant flooding and property damage.

California precipitation comes both as rainfall and snowfall in the high mountains. Rainfall runs off immediately, and water managers must decide whether to store this water in reservoirs for water supply or to release water to reduce future flood risk (Knowles et al. 2006). Snowpack provides a critical second source of water. California reservoirs begin to release their stored water as precipitation declines in late spring. These reservoirs are then refilled by snowmelt from carefully metered mountain snowpacks. Typically, snowpack provides just under half of California's water supply (Dettinger 2015), allowing seasonal redistribution to proceed into the late fall when the rains normally begin again.

Year-to-year variability in precipitation is a predominant feature of the California climate and is by far the greatest in the U.S. (Dettinger et al. 2011). If one or two large winter storms do not materialize, the year will be dry; if there is an additional large storm or two, the year will be wet. Complex cycles of ocean climate[2] contribute to a tendency for wet or dry periods to occur over multiple years, adding another layer of complexity to the water supply picture (Cayan et al. 1998). The reservoirs were originally designed to buffer the effect of precipitation variation, but as demand has grown the system has become increasingly less flexible. The capacity of reservoirs in the Sacramento and San Joaquin basins is about 1.1 times average annual runoff (Lund et al. 2007). Thus, reservoirs allow water managers flexibility for within-year water management but no longer provide much flexibility for dealing with multi-year droughts. Finally, long-term trends in California's water supply associated with climate change portend growing uncertainty in water supply and uncertainty about strategies for coping with increasing variability (see *Uncertainties* at right).

For decades, groundwater has provided the backup to lessen the effect of surface water variability. Of the total California water supply, about 40% comes

UNCERTAINTIES ABOUT CALIFORNIA'S FUTURE WATER SUPPLY ARISING FROM CLIMATE CHANGE

- More precipitation falls as rain in late winter and less as snow in mid-winter.
- Spring snowmelt occurs earlier because of higher temperatures.
- Less snow and earlier melting means less water stored as snowpack and more uncertainty about water availability from reservoirs in the late summer and fall.
- Higher temperatures yield less runoff from the same rainfall amount.
- Average precipitation increases in northern California but decreases in southern California.
- More frequent extremes: prolonged drought, floods from atmospheric rivers.
- Greater dependence on groundwater as a buffer from extremes.
- Increasing costs and decreasing availability of that buffer as groundwater is over-exploited.

Sources: Cloern et al. 2011, Dettinger and Cayan 2014

from groundwater wells (CDWR 2014). But in some regions groundwater is being used faster than it is being replenished. For example, groundwater supplies in the Central Valley have decreased by about 79 million acre feet since the early 1960s (CDWR 2014; Famiglietti et al. 2011). The current drought has greatly exacerbated the issue. From spring 2013 to spring 2014, before the worst of the present drought hit, groundwater levels dropped in 88% of the wells in California, with 22% of those wells dropping by more than 10 feet in that one year. As groundwater levels drop, costs increase, availability declines, and land subsidence occurs (Faunt and Sneed 2015). These signs of groundwater depletion add considerable uncertainty to the supply picture for the future. Exact measurements of groundwater reserves and the cost to access and use groundwater under different future climatic scenarios are crucial to understand the implications of current rates of groundwater depletion. In 2014, California passed legislation requiring that groundwater reserves be measured and groundwater use regulated. Implementation of this new law will require increased study and monitoring of the groundwater system at local, regional, and statewide scales.

Water Quality Complexity

A broad array of nutrients and potentially toxic chemicals enters the Delta from agricultural runoff, and there exists a long legacy of mining and industrialization in the watershed (van Geen and Luoma 1999; see Contaminants at right). Today, more than one hundred industries, wastewater treatment plants, and urban stormwater discharges release waste streams to the Bay and Delta (van Geen and Luoma 1999). The waste streams are mostly treated, but the Bay and Delta are, nevertheless, listed under the federal Clean Water Act as impaired because of the presence of a variety of toxic contaminants. People are advised not to eat striped bass, white sturgeon, and some diving ducks caught in the Bay and Delta because they may contain high concentrations of mercury, selenium, PCBs, or DDT breakdown products.

The complex spectrum of chemicals entering the Delta is continually changing over time as regulations, industry processes, and consumer preferences change. Federal and state regulations (e.g., the Clean Water Act, passed in the 1970s) have made substantial progress in reducing inputs of some toxic chemicals (metals, some organic compounds) into the Bay and Delta (van Geen and Luoma 1999) and reversed adverse ecological effects around what were once contamination hot spots (Hornberger et al. 1999). Nutrient input remains a source of concern, although management has improved in some areas (see Nutrients p. 20). Newly emerging contaminants pose another concern, and include pharmaceuticals, flame retardants and personal care products that are shown to cause endocrine disruption in fish and other organisms. There is evidence of toxicity to invertebrates at the base of the food web, at least near the sources of inputs for some pesticides (Weston and Lydy 2010) and PCBs (Jannsen et al. 2011). In addition, selenium causes reproductive effects in some native fish (Stewart et al. 2013). Finally, the fate of chemical wastes is interwoven with the physical characteristics of the modern Delta. Many aspects of water quality are affected by river inflows, Delta hydrodynamics, connections to the Bay, and changing temperature and turbidity. All of these interact with each toxic chemical to create variable exposures over time and space. In short, there is cause for concern about the potential for adverse effects from toxic contaminants, even though exact risks are difficult to assess and are confounded with the effects of other stressors.

Ecological Complexity

Before European colonization, the Delta was a vast, 3000 square km complex of low, forested islands, tule marsh, and meandering channels (Fig. 3). Parts of the Delta flooded and drained with each tidal cycle, and most of the Delta flooded during the spring, after which parts dried out during the long period of low river flow in the summer and autumn. The tidal and seasonal cycles of flooding, draining, drying, erosion and deposition created and sustained the Delta. This was the environment in which native species evolved and in which they thrived. The life cycles of many native species were cued to these natural rhythms. As tides rose and inundated island marshes, fish would invade the marsh along tidal

CONTAMINANTS IN THE DELTA AND SAN FRANCISCO BAY

- Mercury from historic mining sources contaminates food webs.
- Selenium from Central Valley irrigation drainage and Bay refineries affects reproduction of native predator species in the Bay.
- Organic chemicals remaining in sediments from historic use accumulate in food webs including DDT and its breakdown products, and polychlorinated biphenyls (PCBs).
- Pharmaceuticals, flame retardants, and personal care products from waste treatment facilities disrupt endocrine systems of aquatic organisms and birds.
- Multiple, changing pesticides from agriculture and urban uses cause toxicity at least near their points of release.
- Nutrient inputs from waste water treatment facilities and other sources affect Delta food webs.
- Nitrogen, phosphorous and other nutrients stimulate nuisance or toxic algal blooms and water weeds as turbidity of water declines.



Emergency barrier erected on the False River in 2015 to prevent salinity intrusion into areas tapped for drinking and irrigation water. Photo: Bird's Eye View

"Times of severe drought provide a stark reminder of the complexities of current and future Delta challenges. Drought also underscores the importance of planning for a rapidly changing world. Quick fixes to solve one problem may be necessary, but holistic integrated solutions are ultimately required."

— CLIFFORD DAHM

NUTRIENT INPUTS: A CHANGING ISSUE WITH REGIONAL IMPLICATIONS

- The waterways of the Delta are enriched with nitrogen, phosphorus, and other nutrients that come from natural sources, agricultural inputs and wastewater treatment facilities.
- Nutrients typically fuel the growth of phytoplankton (open water algae) and aquatic plants that form the base of the food web in the Delta. Plant productivity determines the availability of food resources to zooplankton, aquatic invertebrates, and fish.
- Annual primary production of the phytoplankton in the Delta has typically been low compared with other estuaries because of limited light penetration into turbid waters and the low residence time of water in the Delta (Jassby et al. 2002). Feeding by bottom-dwelling animals that filter the water column also reduces phytoplankton availability to the pelagic food web.
- Summer blooms of a harmful algae (*Microcystis aeruginosa*), that began in 1999, are a new concern (Lehman et al. 2005), for the first time raising the specter of ecological problems from nutrient inputs.
- The problem has been accentuated by an increase in the clarity of the water that allows more light penetration. This occurred as the residual sediments from hydraulic mining passed through the ecosystem and dams captured sediments that originated upstream.
- Nutrient availability, especially ammonium from wastewater treatment plants, facilitated the invasion of two non-native aquatic plants (Brazilian waterweed and water hyacinth) which are now well established in the Delta (Santos et al. 2009). Both grow well in high nitrogen environments if light is available, and are effective at using ammonium as a source of nitrogen.
- Programs are being initiated to reduce nitrogen discharges. A sustained commitment to experimental nitrogen-removing technologies illustrates that creative new ways to address stressor problems exist. Although it is uncertain to what degree nitrogen reductions alone will shift trajectories for native species, it is an example of bold, prudent action with a low probability of cascading negative outcomes.



Photo: Bird's Eye View

channels, feeding on the abundant food resources of the marshes before retreating into the main Delta channels as the tide ebbed. Shorebirds would also populate the emerging mud flats to probe for food. Fish species such as splittail were adapted to the seasonal flooding, moving onto the floodplains to spawn during the spring floods and retreating to the main river channels with their young as the flood receded.

Very little of this historic ecosystem remains (Fig. 3). The modern Delta is a patchwork of leveed islands separated by channels. These islands do not flood on tidal or even seasonal cycles, unless levees fail. Little wetland habitat remains, and what does is not subject to the extent of flooding and drying that characterized the historic wetlands.

Beyond transformation of Delta habitats, human development imposes a wide array of additional drivers of environmental change (Fig. 2) with effects that vary among species, locations, and with time. The severity of the cumulative effects of these stresses is manifested in the estimate that 80% of native fish species are in decline (Hanak et al. 2011). Many of the risks from individual stressors are understood, but the relative importance of each stressor to the cumulative consequences is difficult to pinpoint. Moreover, natural cycles and climate change constantly shift the baseline conditions in the ecosystem (Cloern and Jassby 2012), adding to the complexity of determining why changes are occurring. As a result, predicting the outcome when water operations, land forms, or the levees are changed is uncertain, at best.

Since passage of the Central Valley Project Improvement Act of 1992, federal and state agencies have focused attention on how to sustain viable populations of native species in the Delta while still maintaining water exports from the Delta. Early attention focused on prevention of mortality at the export pumps (see Preventing Mortality p.21) and management of flows through the Delta for the benefit of native species. More than a decade of litigation has been driven by uncertainties about the effectiveness of the regulations that curtail exports, and how these curtailments and other water management operations, in real time, negatively affect the populations of legally

PREVENTING MORTALITY OF LEGALLY PROTECTED FISH SPECIES IN THE DELTA

- One focus of Delta management is regulations that curtail water exports when legally protected species, such as salmon and Delta smelt, are drawn into the pumps.
- At a larger scale, water project operations also affect water movement and water quality throughout the greater Delta changing, for example, cues that fish such as salmon use to direct their seasonal migration from spawning rivers to the sea and back.
- Today only 5% of the young salmon that enter the Delta in their seaward migration survive to enter the ocean (del Rosario et al. 2013). That proportion dropped from 40% in the 1990s.
- It is difficult to determine unambiguously how much of this mortality is caused by water operations, how much by habitat change or how much by interactions with other causes of mortality such as predation by non-native species (Fig. 2).
- Survival of migrating chinook salmon has been improved to 86 – 94% by scientifically supported actions in the Columbia River system (northwest US; Muir et al. 2001). This means improving migratory survival is feasible and is an example of an opportunity to improve the situation for native species.



Steve Martarano/ USFWS

HOW MUCH WATER FOR THE ENVIRONMENT?

- It is common to hear that only 50% of California's water supply is diverted for human use and that the other 50% goes to the environment. (Different sources give slightly different figures for the water balance.)
- In general, one-third of all California water (60% of the environmental water) is in wild and scenic rivers far north of the Delta watershed. These rivers are protected by laws that were established in the 1960s and have been repeatedly declared off limits to the Delta because of poor accessibility, environmental protection and economic reasons.
- The most controversial segment of all water is the approximately 10% (20% of environmental water) that flows through the Delta.
- Most of this water is used for increasing flow that prevents salinity intrusion into the Delta pumping stations. This water may be beneficial to the environment, but it is just as important to human water uses.
- 1-2% of the water is used for wetlands maintenance, which is not highly controversial.
- Most of the controversy is over the 1% or so of the water used to protect endangered species of fish.
- California's recent water wars are about this last remnant of the original inflows to the Delta, a sign of the tightening supply versus demand equation.

Sources: Fox 2015; Mount 2011

THE PELAGIC ORGANISM DECLINE

- Four pelagic species, two native species (Delta smelt and long fin smelt) and two introduced species (juvenile striped bass and threadfin shad), declined to record low numbers in only a few years beginning in 2002 - 2004.
- The collapse of these populations occurred despite management actions intended to improve conditions in the Delta and relatively moderate hydrological conditions at the time.
- Before this event, most attention had focused on water exports as the principal cause of the declining abundance of native species. Careful re-examination and re-analysis of data was catalyzed by the dramatic change in fish populations.
- Although different stresses (Fig. 2) figured most prominently in different studies, all showed that direct effects of water exports was only one factor - and perhaps no the most important factor - in this most recent species decline in abundance.
- Conceptual models, rooted in ecological theory, are developing ideas about how a number of drivers of change interact to cause precipitous declines in species. These models are qualitative and generalized, but do provide a useful framework for organizing and synthesizing both data and ideas related to the conservation of pelagic fish species.



Delta smelt. Photo: Dave Giordano, Ecositemedia

protected fish species. Even defining water allocations for the environment versus human use has been a source of controversy (see How Much... p. 21).

As more has been learned about the Delta ecosystem, it is clear that recovery of native species will require cumulative effects from all stressors to be addressed. A good example of the dire circumstances that characterize the Delta ecosystem is the recent sharp decline of several native fish species, termed the pelagic organism decline or POD (see Pelagic Organism above). Statistical studies, improved conceptual models, and improvements in quantitative modeling of the environment all point to multiple causes for the POD, and perhaps a broad change in the overall ecological regime of the Delta. Initial studies of the POD were focused on declines in abundance of a few species such as Delta smelt or longfin smelt and their link to water diversions. But broader conceptual models (e.g., IEP MAST 2015) led to the recognition that more species and other events were involved with this change. The idea that focusing action on one problem will allow relaxation of the regulation of others has underlain much of the contentious dialogue about Delta restoration. The POD studies and others show that concerted action on multiple fronts offers the best opportunity for progress.

It is difficult to pin down the causes of events such as the POD, in large measure because today's Delta is essentially an alien habitat to the hundreds of native species that try to live there. Under these circumstances, it is no surprise that many native species are struggling to survive and that many factors are implicated in their low population numbers. The Delta cannot be returned to the way it was 200 years ago. The great challenge is to figure out how to provide enough suitable living space in the modern Delta for these species to persist (Moyle et al. 2012). The challenge is increased by the continually evolving nature of the ecosystem as new species arrive, and as land use and climate change (see Non-Native Species p. 23).

Institutional Complexity

Because managing water and environment is inherently complex, the tendency is to break the perceived problem down into what seem like manageable pieces and address each piece more or less independently. The result has been a plethora of agencies, departments, and commissions at federal, state, regional and local levels of government, each dedicated to addressing one or more components of water and environmental management (Fig 4). Private interests, like the State Water Contractors, and non-governmental organizations, like the San Francisco Estuary Institute and the Nature Conservancy, are also involved. The repeated crises in management of the Delta have only served to increase this institutional complexity (DSC 2013).

When so many institutions with different mandates are involved in management of a critical resource such as the Delta, integration and coordination are critical.



Small irrigation pump draws from Delta waterway infested with invasive aquatic plants (left); Overbite clam (below). Photos: Bird's Eye View and Andrew Cohen (respectively).

Although there are notable examples of long-standing cooperation and integration among state and federal agencies (the Interagency Ecological Program, for example), there are also notable examples of decision-making that is fragmented and uncoordinated, leading to inef ciency and poor outcomes (NRC 2012). One consequence of the fragmentation of responsibility and authority over the Delta is the increased dif culty of addressing Delta problems. The complexity provides a multiplicity of ways for individuals and organizations that are dissatis ed with water or environmental management to seek redress for their dissatisfaction through litigation. The Delta Reform Act of 2009 attempted to address this complexity by establishing the Delta Stewardship Council with responsibility for achieving the coequal goals of a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. Time will tell whether the Council can achieve suf cient cooperation or has suf cient authority to address institutional complexity.

NON-NATIVE SPECIES AND THE RESTORATION CONUNDRUM

- Aquatic and terrestrial habitats are heavily invaded by non-native species delivered by international shipping, recreational boating, the horticulture and pet industries, agriculture, or deliberate introduction.
- San Francisco Bay and the Delta have been described as the most heavily invaded estuary in the world (Cohen and Carlton 1998). Cohen and Carlton (1998) showed that 40-100% of species found in various aquatic habitats was non-native.
- The consequences of invasions by exotic species can be dramatic.
- A 1986 invasion of the overbite clam changed phytoplankton dynamics in Suisun Bay, and eliminated what was once a large spring bloom of plants essential to native food webs.
- Introduced predators, like striped bass and largemouth bass, have grown to large populations in the Delta, and their predation on native shes is thought to contribute to the decline of such species.
- Restoration of shallow water habitats is often plagued by invasive plants and invasive predators instead of fostering more habitat for native species. Currently, it is unclear how best to reduce populations of invasive species or how to increase the certainty that new habitat will be best suited for native species.



The Role of Science

As we noted earlier, the Delta is one of the most studied ecosystems in the world. A growing understanding underpins ongoing adaptations in managing the Delta. Throughout the decades of con ict over water issues, all parties have recognized that advancing the state of scienti c knowledge is fundamental to making constructive progress. As we enter an era of increasing uncertainty about climate and water supply, commitments to multi-institutional science that informs policy beyond agency decisions are critical. Continuing advancement of scienti c understanding and effective integration of science into management will require science that embraces differences of scienti c opinion, structures science in a way that is useful for management decisions, and quanti es uncertainty. Looking into the future of complex problems like the Delta will require scienti c models that can simulate the consequences of different management approaches. Such models have been developed for water operations; are in their early stages for the ecosystem (DiGennaro et al. 2012) and climate change (Cloern et al. 2011); and have been used to envision alternative futures for the Bay-Delta (e.g., Lund et al. 2010). The understanding necessary to integrate and strengthen these models is growing rapidly, but is scattered among agencies and research institutes and needs to be brought together. Challenges remain in merging models of various types, and in ensuring the model output is suf ciently reliable for management. But if carefully implemented and interpreted, such models can provide valuable guidance to policy, management, and science (Healey et al. 2008).

Continuously improving models and scienti c understanding of the Delta problem is necessary but not suf cient to manage successfully the complex technical, political and resource challenges facing the Delta. There will always be uncertainties that surround any action. Dif cult political choices will be necessary. Adaptive management is the preferred approach to implementing management actions in the face of uncertainty. Regular monitoring and evaluation of the Delta's response to management is the best way to detect unexpected outcomes and adjust management actions to deal with uncertainties. Although a number of monitoring and assessment programs exist to aid in such evaluations, there is not as yet a uni ed set of performance criteria for the key dimensions of the Delta problem. As adaptive management becomes more fully implemented, such criteria must be developed, implemented, and reported on regularly. Effective adaptive management also requires collaboration, communication, and transparency among all interest groups as well as a willingness to overcome the institutional barriers to collaborative decision-making. Recent commitments to collaborative decision-making are encouraging (e.g., the Collaborative Adaptive Management and Policy Team) but sustaining those initiatives has always been a challenge.

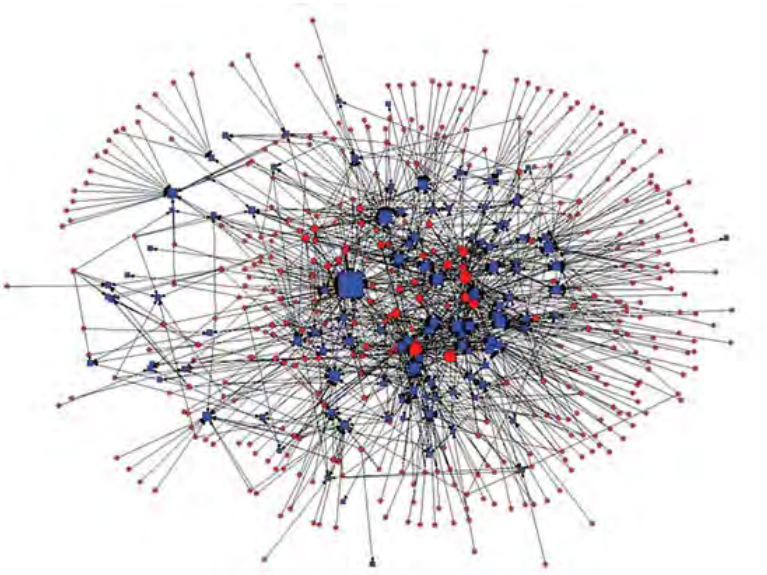


FIGURE 4. Complexity diagram of actors (red circles) and institutions (blue squares) involved in water governance of San Francisco Bay (With permission from Lubell et al. 2014).

CONCLUSION



Fishing family along the Sacramento River.
Photo: Bird's Eye View

Continuously

improving models and scientific understanding is necessary but not sufficient to manage successfully the complex technical, political and resource challenges facing the Delta. Difficult political choices will be necessary in the face of uncertainty. Risks can be reduced by tracking the response of the Delta, in all dimensions, and adjusting actions accordingly

Conclusions: Coping with Complexity

The Sacramento-San Joaquin Delta is at the hub of an interconnected water-delivery system that feeds the impressive economy of California and also in uences the economies of most of the western U.S. At the same time, the Delta is an ecological resource of international signi cance with a rich social and cultural history. The challenge in managing the Delta is to preserve all these important functions in the face of a widening demand for water that frequently exceeds available supply, including demand from a growing population, a growing economy, valuable agriculture, and a unique environment. The challenge is enhanced by climate change, which is raising temperatures, changing storm patterns, and reducing snowpack, leading to an increasingly uncertain supply of water and changing environmental conditions. Unsustainable mining of groundwater (Bredehoeft and Alley 2014) is increasing costs and decreasing the availability of a source of water that has long provided a buffer against drought. Water managers no longer have the exibility they once had in dealing with the multi-year droughts that are inherent to the California climate. Managing the water supply system alone is complicated. But add in the imperative to sustain the ecological and social values of the Delta and every decision becomes considerably more complex. The current arrangement for addressing this combination of complexity, uncertainty, and change is unsustainable as evidenced by both declines in native species and dissatisfaction with water deliveries.

From an environmental perspective, the ecosystem of the Delta is vastly transformed from its original state, making life dif cult for a host of native species. Multiple interacting factors affect the well-being of native species. Some of these factors are well understood, but their interactions and cumulative consequences are not, making it impossible to make de nitive statements about what is causing native species to decline. As a result, predicting the outcome when water operations, land forms, or the levees are changed is uncertain, at best. Nevertheless, opportunities exist to conserve and restore aspects of the native system and to structure the rest of the Delta to make it more hospitable to native species. Realizing those opportunities without jeopardizing water supply is the ultimate challenge in managing the Delta.

Many of the approaches used in water-scarce environments elsewhere are under-utilized in the Delta. While adjustments to the infrastructure as it ages are essential, opportunities exist to simultaneously rede ne bold action as we pursue proven (although not always initially popular) ways to work more effectively with what we have (www.energy.ca.gov/wet/). Examples include the following:

- Groundwater recharge and conjunctive use offer storage potential beyond that available for surface waters (CIWR 2015).
- Initiatives to promote water reuse, water recycling, and desalination in selected circumstances are under-utilized and can help address the imbalance between demand and supply (ACWA 2015).
- Priorities for maintenance and upgrades of the levees can be built from growing understanding of physical vulnerabilities, climate change, economics, and water transit needs (DSC 2015).
- Making water conservation a continual, long-term, statewide investment is a necessary part of accepting water scarcity (USEPA 2015; NatGeo 2014).
- Greater attention to both the tributaries and the Bay in Delta planning, including wetlands restoration, offer opportunities for both protection from sea level rise and ecosystem restoration (Save the Bay 2015).
- Continuing the precedent of improving water quality from tributary inputs and within Delta sources can help counter the expansion of exotic species (Brown and Caldwell 2015).

- Risk reduction for catastrophic Delta infrastructure failure can include investing in targeted levee improvements, addressing additional stresses from sea-level rise and planning for climatic extremes such as atmospheric rivers and long-term droughts.
- Making the "One Delta, One Science" concept a reality will improve the underpinning for political actions in the face of uncertainty (DSP 2013).

Complex, wicked problems like the Delta rarely yield to the simplistic solutions directed at only one dimension of the problem. The lack of exibility resulting from the already complete allocation of a shrinking water supply, combined with the serious deterioration of the native ecosystem, will reduce the effectiveness of many traditional engineering solutions in the Delta. History shows that large-scale, irreversible, physical changes in the water system are particularly risky (see San Luis Drain opposite) unless they promote exibility and are implemented incrementally (see South Florida Example p. 28). Incremental, as used here, does not imply "small," but "implementation in stages" such that lessons learned from early increments can be used to improve design of later increments. While economics alone may not always support such an approach, it is time to recognize that other dimensions of the issue also must carry weight.

New approaches to scenario-building and modeling can help managers explore the potential outcome of major management initiatives and anticipate problems before they arise. Modeling and scenario-building needs to be a collaborative, multi-institutional activity. As we enter an era of increasing uncertainty about climate, water supply, the fate of the Delta's native ecosystem, and institutional complexity, multi-institutional collaborative approaches will become increasingly important.

IMPLEMENTING INADEQUATELY UNDERSTOOD ENGINEERING SOLUTIONS: THE SAN LUIS DRAIN EXAMPLE

An example of implementing a simple solution to a complex problem is the issue of irrigation drainage in the Central Valley.

- As a part of the Central Valley Water project in the 1950s, governments were obligated to deal with the return drainage that resulted from the export of water from the Delta.
- The simplest solution was to build drainage infrastructure under the agricultural elds and a canal (the San Luis Drain) to take the drainage to San Francisco Bay.
- The rst increment of that system was completed in the 1980s with the drainage canal temporarily terminating near Kesterson Wildlife Refuge.
- Soon after the drainage disposal began, severe deformities were observed in birds, including birds that were part of the international Paci c Flyway. Later studies showed a massive ecological disaster, which was eventually attributed to heretofore unknown selenium contamination in the drainage (Presser 1994).
- Later studies showed that a similar, if not worse outcome was likely if the drain was extended to the Bay (Presser and Luoma 2000).
- Dealing with this problem has been much more expensive than the San Luis Drain itself. Adverse effects of irrigation drainage products such as selenium will always be an important consideration in any plans that change water redistribution systems. The selenium problem cannot be solved, but it is being incrementally managed by land retirement and multiple, local in-valley treatment systems. The San Luis Drain was a multi-million dollar "stranded investment" that resulted from a poorly understood, simplistic engineering "solution" to a complex problem with many dimensions.



FIGURE 2. SAN JOAQUIN MASTER DRAIN

San Joaquin Valley master drain plan circa 1965. Map: DWR

INCREMENTALLY APPROACHING A COMPLEX PROBLEM: A SOUTH FLORIDA EXAMPLE

Most Delta restoration projects have not been in place long enough to draw conclusions about the approaches being used. But the Kissimmee River in south Florida provides an example of how an incremental approach to restoration can work. Key elements of this widely proclaimed restoration success are listed here (see Dahm et al. 1995):

- River channelized for ood control from 1962-1971 at a cost of $38 million
- Collapse of key bird and sh communities
- Mounting interest and public pressure for restoration
- Pilot project to reroute some canal water back onto oodplain from 1984-1988 with positive responses from birds and sh
- Design phase for a large-scale restoration in the early 1990s with a rigorous evaluation program
- Testing sediment plug from old spoils piles to see if the channelized river could be rerouted onto the old oodplain in 1996; plug functioned as designed
- Construction of Phase One restoration 2000-2001 for about 30 kilometers of river and 3,200 hectares of wetland
- Initial restoration largely successful
- Currently carrying out Phase Two of restoration
- Restoration costs to date approaching one billion dollars



Kissimmee River restoration, showing flood control channel filled in so river meanders could be restored.
Photo: South Florida Water Management District

Water scarcity has de ned and will continue to de ne the future of the Delta and all that is linked to it. California has risen to the challenge of water scarcity in the past to build an economy and a society that is, in many ways, the envy of the world. The present problem of water scarcity seems more complex and less amenable to traditional engineering solutions than in the past. But California has the tools and the intellectual resources to manage the problem and to achieve the twin goals of a reliable water supply and an ecologically diverse Delta ecosystem.



Yolo Bypass floodplain during drought.
Photo: Bird's Eye View

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As we enter an era of increasing uncertainty about climate, water supply, the fate of the Delta's native ecosystem, and institutional complexity, multi-institutional collaborative approaches will become increasingly important. California has the tools and the intellectual resources to manage these problems and, as difficult as they are, achieve the twin goals of reliable water supply and an ecologically diverse Delta ecosystem.

Footnotes

1 Widening demands for water are expected from projected population growth, economic growth, and demands to use water for the environment. The Delta Reform Act of 2009 states its "coequal" goals as "providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place" (CA Water Code 85054). "Widening" means overall demand, not necessarily increasing demand per capita.

2 The El Niño Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO) phenomena are two examples of ocean climate influences (http:/ / www.pmel.noaa.gov/ tao/ elnino/ el-nino-story.html).

3 http:/ / www.bloomberg.com/ news/ articles/ 2015-01-16/ brown-s-california-overtakes-brazil-with-companies-leading-world
http:/ / ajed.assembly.ca.gov/ keyinsightsintoinnovation and https:/ / www.census.gov/ foreign-trade/ statistics/ state/ data/ ca.html
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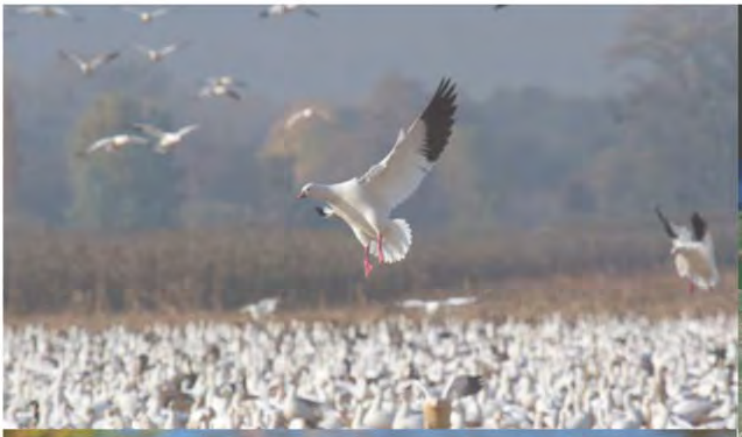
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North-of-the-Delta Offstream Storage



Investigation Highlights

May 2014

PUBLIC SAFETY ENVIRONMENTAL STEWARDSHIP ECONOMIC STABILITY



INVESTIGATION HIGHLIGHTS
A Summary

• North-of-the-Delta Offstream Storage (NODOS) would provide a robust set of benefits, including water supply reliability for municipal and industrial uses, agriculture, and wildlife refuges; ecosystem enhancement actions to improve fish survival in major northern California rivers and the Sacramento-San Joaquin Delta (Delta); water quality improvements for Delta water users and estuarine species; flexible hydropower generation to support renewable energy sources such as wind and solar; recreation opportunities at the new reservoir and improved recreation at existing reservoirs; and local flood damage reduction below the new reservoir. Total water supply benefits would be up to 500 thousand acre-feet (TAF) per year on average and over 600 TAF per year during dry and critical years.

• The mix of NODOS benefits would also support improved flexibility and long-term viability of the Central Valley Project (CVP) and State Water Project (SWP). As the current drought is showing, flexibility of these projects is impaired during multiple dry years or droughts. In addition to providing the benefits described above, NODOS would improve CVP and SWP flexibility by increasing water in storage, including during drought conditions. Average annual improved storage would be up to 1.4 million acre-feet (MAF); annual drought period storage would be improved by up to 1.1 MAF.

• Estimated project cost ranges between $3.6 billion and $4.1 billion.

• Benefits would exceed costs. Net benefits, or the total economic value of annual benefits would exceed total annual costs by $61 million, $77 million, and $72 million for Alternatives A, B, and C respectively. The benefit-cost ratios for the three alternatives would be 1.32, 1.43, and 1.35 respectively.

• NODOS benefits would be resilient. A slightly modified operation and emphasis of objective priorities would be required with Bay Delta Conservation Plan (BDCP) conveyance and operations. The mix of water supply benefits would remain robust. NODOS operations would also be resilient to climate change effects, including potential changes in runoff and sea level rise. Total water supply benefits decreased by 4% in one BDCP scenario; and total water supply benefits increased or were unchanged in the climate change scenario and the BDCP with climate change scenario.

• Public benefits can be quantified for the benefit packages evaluated. The currently released reports do not include the final cost allocation, which would provide an approach to determining public and non-public investment needs. Even so, a preliminary cost allocation estimates the public benefit allocation at about 40%, including ecosystem restoration, water quality, water supply reliability for wildlife refuges, recreation, and flood damage reduction.

• The impacts of NODOS implementation are evaluated and potential mitigation measures are described in the Preliminary Administrative Draft (PAD) Environmental Impact Report (EIR). DWR is not soliciting and will not respond to comments submitted on this PADEIR, although any comments received will be retained and may be considered during preparation of a future public draft EIR.

• The Governor's California Water Action Plan (Water Action Plan) directs the California Department of Water Resources (DWR) to work with the Legislature, U.S. Bureau of Reclamation (Reclamation), and Sites Project Joint Powers Authority (JPA) to help facilitate a funding partnership in support of a financeable, multi-benefit storage project.

Introduction

The Governor's Water Action Plan and the current drought have re-energized discussions of the need for more storage. The Water Action Plan presents water challenges facing California and lays out three over-arching goals: reliability, restoration, and resilience. One of ten actions to meet these goals is, *"expand water storage capacity and improve groundwater management."* This document highlights how NODOS would improve the reliability, restoration, and resilience of California's water resources to support the Water Action Plan goals.

Five documents associated with the NODOS Investigation are available online at http://www.water.ca.gov/storage:

- NODOS Investigation Highlights (this report), by DWR
- NODOS Preliminary Administrative Draft EIR, by DWR
- NODOS Investigation 2013 Progress Report, by Reclamation and DWR
- NODOS Preliminary Design and Cost Estimate Report, by DWR
- NODOS Sensitivity Analysis of Operations with the BDCP Technical Memorandum, by the Sites Project JPA

This document highlights important information from these planning documents, which comprise most of the administrative drafts of the environmental and feasibility reports being prepared for the investigation.

Offstream storage reservoirs located north-of-the-Delta have been studied since the 1940s. The CALFED Bay-Delta Program (CALFED), a cooperative Federal and State agency partnership, recommended further study of NODOS in 2000. DWR and Reclamation are nearing completion of a Feasibility Study, including an EIR/EIS and Feasibility Report, in cooperation with local and regional water interests.

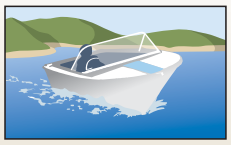
An initial step in the NODOS Investigation was consideration of problems and needs in the study area, which defined the NODOS planning objectives. The project objectives and portfolio of benefits are shown in Figure 1. Additionally, operational flexibility would be supported by additional water in storage. Operational flexibility of the SWP and CVP systems has diminished over time. Contractual commitments to water users, as well as water quality and fish survival requirements, have all increased since California's two largest water projects were built. These increasing demands on the systems have resulted in less water in storage. The CVP and SWP systems have become increasingly inflexible—a "loss of resiliency," as described in the California Water Plan Update. As the reservoirs are operated to meet these increasing commitments, additional stressors are anticipated. Climate change effects will require increased reservoir releases to maintain Delta salinity and to control water temperatures downstream of existing reservoirs.



NODOS would take advantage of existing water facilities, including Tehama-Colusa Canal, as shown here.

Figure 1. Summary of NODOS Objectives and Benefits Portfolio

Flexible Generation
Sites Reservoir would provide flexible power generation, which can quickly ramp up or down to support wind and solar generation.

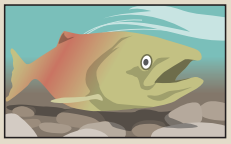


Recreation
Sites Reservoir would provide opportunities for hiking, camping, fishing, and boating.



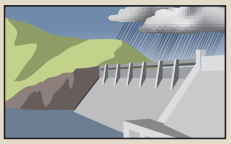
Water Supply Reliability
The reliability of water supplies would be improved by Sites Reservoir and the added flexibility for operating the systems.

M&I and Agricultural Water Quality
Sites Reservoir would improve water quality by dedicated releases to reduce the average electrical conductivity (indication of salinity) and the concentrations of total dissolved solids, chlorides, and bromides within the Delta.



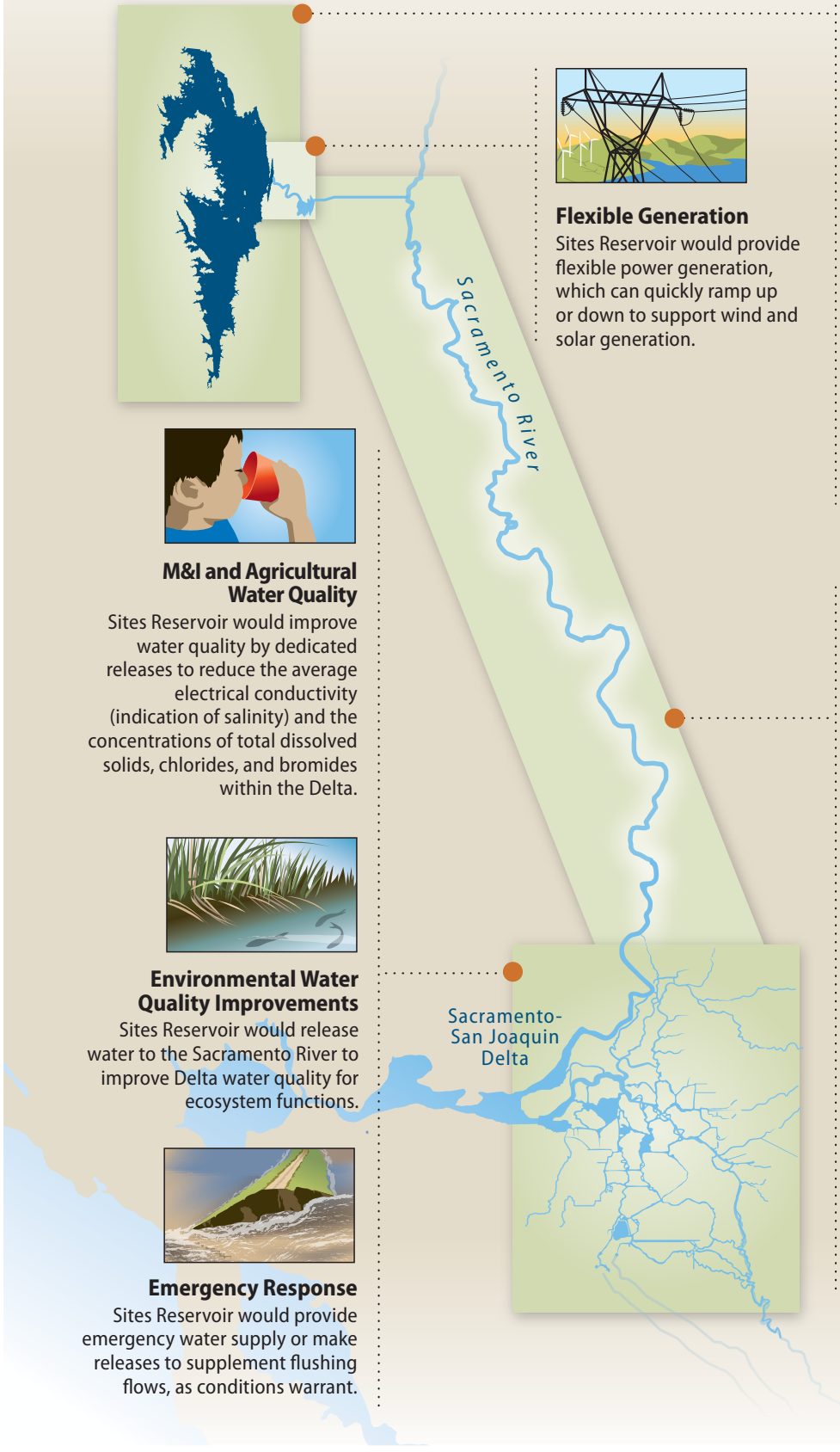
Ecosystem Improvements
Sites Reservoir would dedicate storage to improve cold water management in existing reservoirs and flow and temperature conditions in Northern California rivers and the Delta to support fish survival.

Environmental Water Quality Improvements
Sites Reservoir would release water to the Sacramento River to improve Delta water quality for ecosystem functions.



Flood Risk Reduction
Sites Reservoir would improve flood protection for the local areas downstream of the proposed reservoir.

Emergency Response
Sites Reservoir would provide emergency water supply or make releases to supplement flushing flows, as conditions warrant.



Note: Map not to scale

Through a robust plan formulation process, many reservoir locations were considered and Sites Reservoir was selected as the preferred location alternative. A range of reservoir sizes, various conveyances, and operational scenarios were also considered. The operation of Sites Reservoir is an essential part of the NODOS investigation. The NODOS alternatives evaluated in detail are depicted in Figure 2.

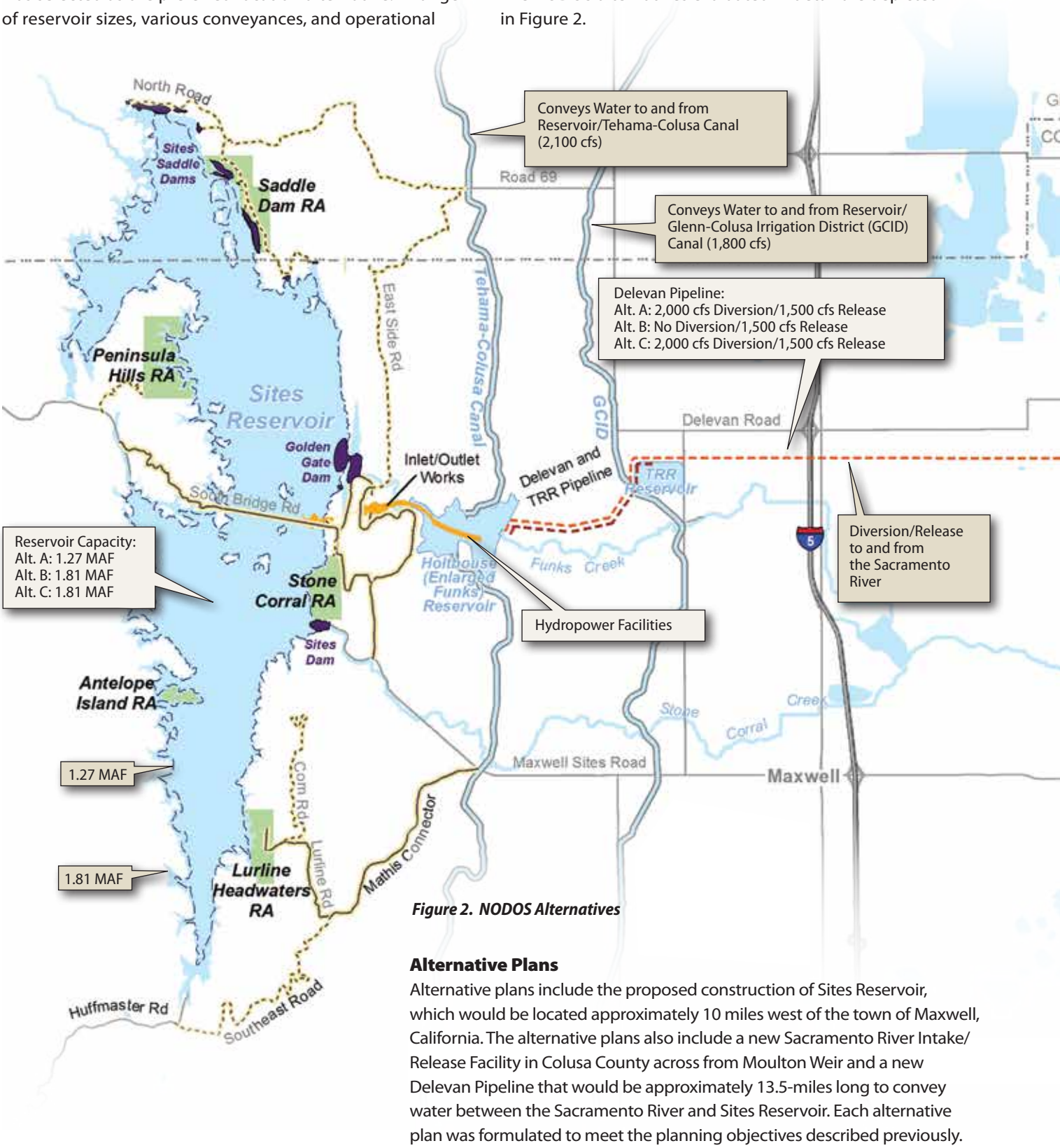
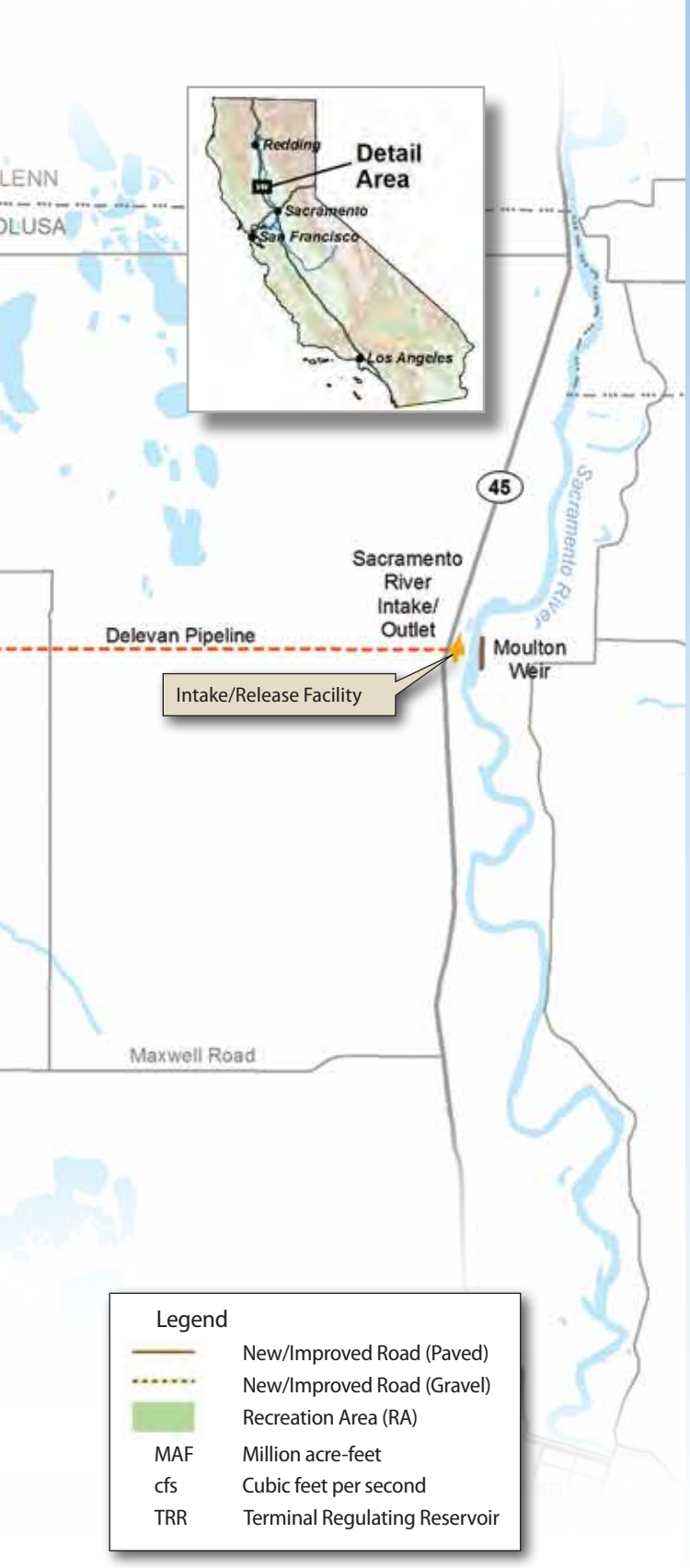


Figure 2. NODOS Alternatives

Alternative Plans

Alternative plans include the proposed construction of Sites Reservoir, which would be located approximately 10 miles west of the town of Maxwell, California. The alternative plans also include a new Sacramento River Intake/ Release Facility in Colusa County across from Moulton Weir and a new Delevan Pipeline that would be approximately 13.5-miles long to convey water between the Sacramento River and Sites Reservoir. Each alternative plan was formulated to meet the planning objectives described previously.



ALTERNATIVE PLANS

No Project/No Action Alternative

No actions would be taken to provide storage north of the Delta to meet the planning objectives.

ALTERNATIVE A:

1.27 MAF Sites Reservoir with Delevan Pipeline

- 1.27 MAF Sites Reservoir with conveyance to and from the reservoir provided by the existing Tehama-Colusa Canal and Glenn-Colusa Irrigation District Canal
- New Delevan Pipeline (2,000-cfs diversion/1,500-cfs release)
- New hydropower facilities
- Ecosystem enhancement actions to support anadromous and endemic fish populations

ALTERNATIVE B:

1.81 MAF Sites Reservoir with Release-only Delevan Pipeline

- 1.81 MAF Sites Reservoir with conveyance to and from the reservoir provided by the existing Tehama-Colusa Canal and Glenn-Colusa Irrigation District Canal
- New release–only Delevan Pipeline (1,500-cfs release)
- New hydropower facilities
- Ecosystem enhancement actions to support anadromous and endemic fish populations

ALTERNATIVE C:

1.81 MAF Sites Reservoir with Delevan Pipeline

- 1.81 MAF Sites Reservoir with conveyance to and from the reservoir provided by the existing Tehama-Colusa Canal and Glenn-Colusa Irrigation District Canal
- New Delevan Pipeline (2,000-cfs diversion/1,500-cfs release)
- New hydropower facilities
- Ecosystem enhancement actions to support anadromous and endemic fish populations

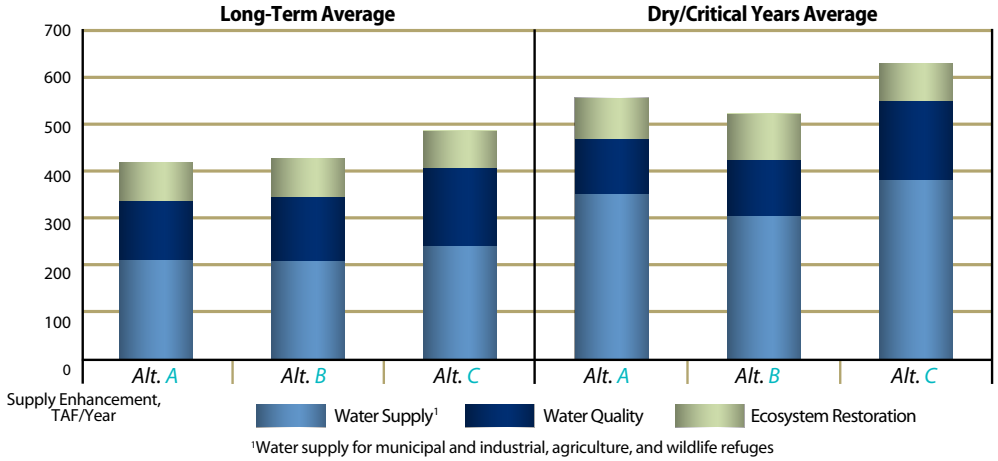
Alternatives Considered and Eliminated From Further Detailed Analysis

Initially, 52 alternative reservoir locations were considered before identifying Sites Reservoir as the preferred location for additional storage. The iterative plan formulation and screening process is documented in the NODOS Preliminary Administrative Draft Environmental Impact Report (2014) and the Progress Report (2013).

Benefits

NODOS benefits focus on reliability, restoration, and resilience for much of California. Benefits would occur from Trinity to San Diego counties (north to south) and Butte to Santa Clara counties (east to west), as well as in the Sacramento-San Joaquin Delta. Water supply benefits are described in three purpose categories: water supply reliability (labeled as water supply), water quality, and ecosystem restoration. Figure 3 shows the quantities of water supply (in thousands of acre-feet (TAF)) dedicated to these purposes for the three alternatives.

Figure 3. NODOS would increase water supply for multiple purposes



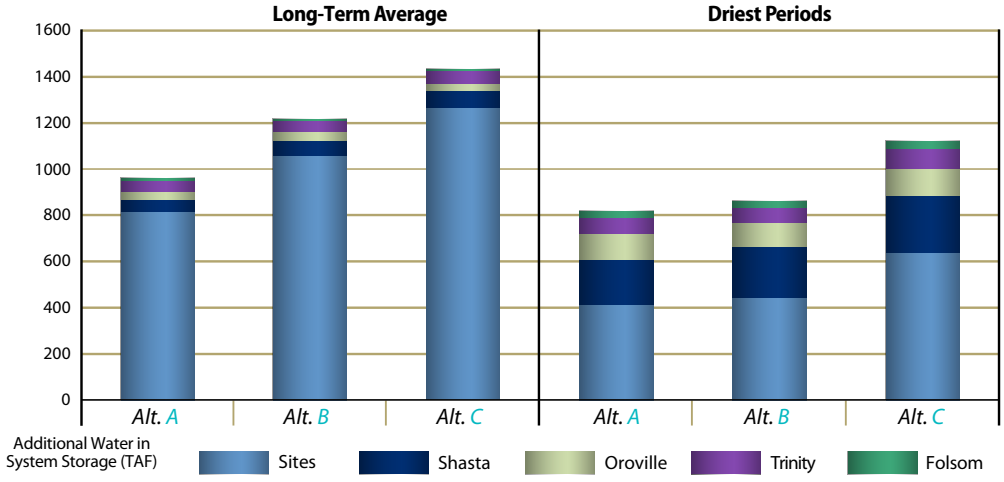
Reliability

Reliability would be improved for all three water supply purposes: water supply, water quality, and restoration. Water supply reliability would be improved for municipal and industrial, agriculture, and wildlife refuge users. Water quality would be improved by providing dedicated supplemental Delta outflow. Restoration water supply would be dedicated to support actions in the Delta and its tributaries.

Average annual water supplies would range from 400 to almost 500 TAF per year. The proposed reservoir's operations have been designed to emphasize supplies during drier conditions. Consequently, when the State is experiencing dry conditions (during Dry and Critical years), water supplies would increase to from 500 to over 600 TAF per year. In addition to these water benefits, flexible hydropower generation to support renewable energy sources such as wind and solar would be included.

NODOS also would support a more robust water system by improving storage conditions in reservoirs north-of-the-Delta (NOD). Figure 4 shows that NODOS would increase the average NOD storage by about 1.0 MAF/year to 1.4 MAF/year; during driest periods (droughts), storage would be improved by over 800 TAF (17% system storage improvement) to 1.1 MAF (23% system storage improvement). Having this additional water in the existing reservoirs would improve fishery conditions below those dams and the viability of the CVP and SWP systems.

Figure 4. NODOS would increase system flexibility through additional water in system storage

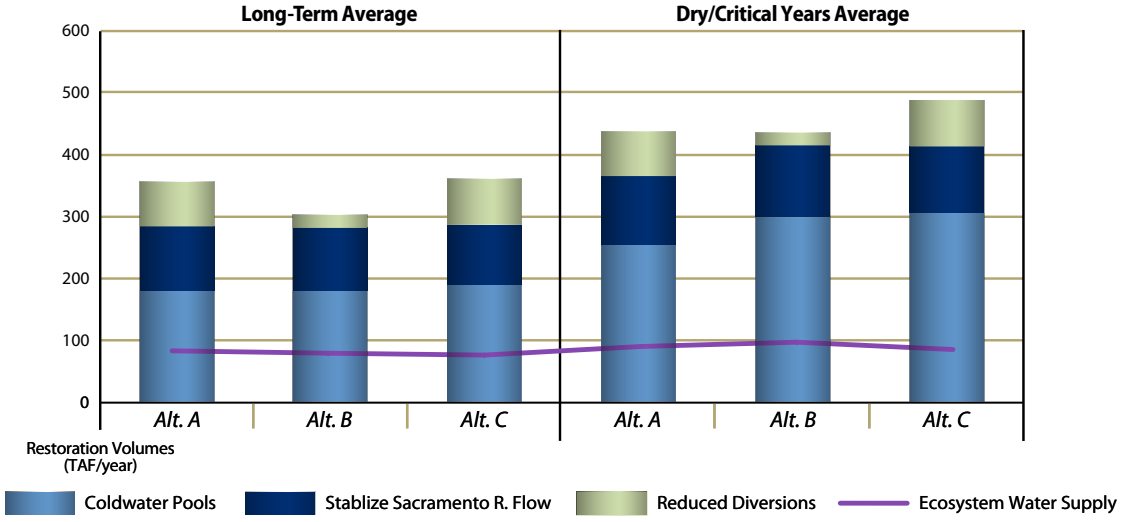


Restoration

Storage from NODOS would provide a source of additional water within the SWP and CVP systems that could be used to facilitate several ecosystem restoration actions to improve conditions in the Delta and Sacramento River watershed. Restoration would be accomplished by providing improved streamflow and lower water temperatures below existing reservoirs and in the Delta to support ecosystem needs. NODOS would improve ecosystem conditions by: increasing the reliability of coldwater pool storage at Shasta Lake (and by extension Trinity Lake), Lake Oroville, and Folsom Lake; providing supplemental releases from Shasta Lake to improve the temperature regime of the Upper Sacramento River; providing stable flow regimes in the Sacramento and American rivers to improve egg survival and fish habitat; increasing the flexibility of the SWP and CVP to meet salinity standards and improving salinity conditions in the Delta with dedicated releases to support estuarine fish species; and providing increased flows (Spring–Fall) in the lower Sacramento River by reducing diversions at Red Bluff and Hamilton City and by providing supplemental flows at the new Delevan Pipeline.

The volumes of water associated with most NODOS restoration actions are shown in Figure 5. Average coldwater pool augmentation at Shasta, Trinity, Oroville, and Folsom would range from 180 TAF/year to 190 TAF/year, while during drier conditions (i.e. Dry and Critical years), coldwater pools would be improved by 250 TAF/year to 300 TAF/year. Supplemental Sacramento River stability flows and reduced diversions are also shown, with average total volumes of water ranging from 300 TAF/year to 350 TAF/year and drier conditions volume ranging from 430 TAF/year to 480 TAF/year. Also shown in Figure 5 is the dedicated restoration water supply quantity from Figure 3, indicating NODOS project efficiencies in providing the ecosystem actions. Much of the restoration water volume would be used again for other purposes. Restoration volumes would be almost four to over five times the restoration water supply.

Figure 5. NODOS would provide Ecosystem Restoration Action Volumes

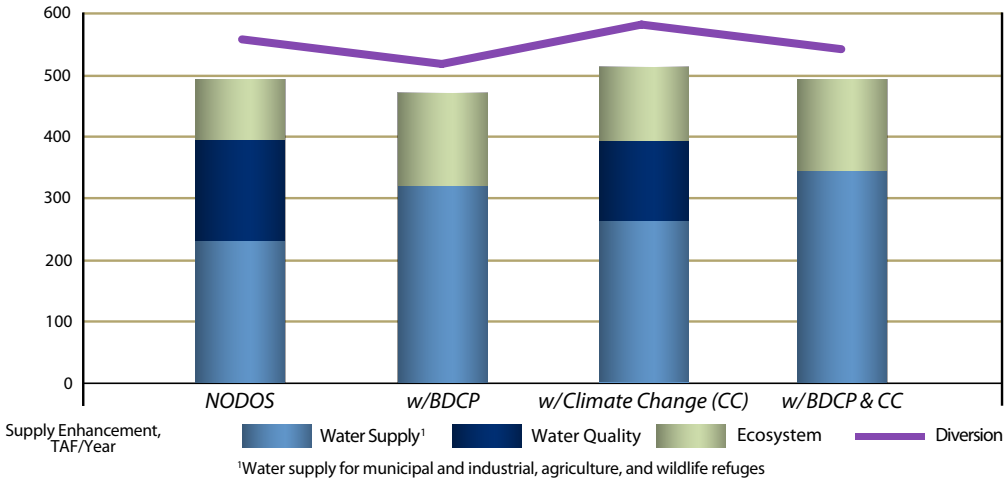




Resilience

The NODOS Investigation evaluated NODOS performance with potential alternative futures, including four climate change scenarios and three BDCP conveyance and operations scenarios. While the operations of NODOS were modified to accommodate alternative futures (particularly with BDCP), sensitivity studies indicate that NODOS performance would be resilient. Figure 6 shows a comparison of NODOS performance (Alternative C) with alternative futures. For example, water diversion to fill NODOS would be reduced by 7% with BDCP, increased by 4% with climate change and sea level rise, and decreased by 3% with both climate change and BDCP. NODOS water quality actions would not be needed with the BDCP scenarios because BDCP would provide significant water quality improvements with its north Delta diversion location. With BDCP, NODOS water would be shifted for uses supporting restoration and increasing water supply reliability. Both water supply reliability and restoration benefits would be increased with each alternative future as compared to the No Action future. Total benefits would be decreased by 4% with BDCP, increased by 4% with climate change, and unchanged with both.

Figure 6. NODOS would be resilient with alternative futures





Benefits and Costs

A comparison of the project benefits and costs indicates economic feasibility, as shown in Table 1. Total estimated project costs range from $3.6 billion to $4.1 billion, resulting in annual costs (including construction, interest during construction, and operations and maintenance) of $178 million to $204 million. The value of annual benefits would range from $249 million to $276 million, resulting in benefit-cost ratios (i.e. Total Benefits/ Total Costs) of 1.32, 1.43, and 1.35 for alternatives A, B, and C respectively. Net Benefits would range from $61 million to $77 million per year.

A NODOS Value Planning Study has identified up to $600 million in total project savings. Proposals for cost savings include use of roller-compacted concrete for the main dams, moving or modifying various reservoir-related structures, and refining pipeline conveyance designs. These cost saving proposals will be considered and incorporated in the NODOS Feasibility Report.

Table 1. Preliminary estimated NODOS benefits and costs ($Million, 2013 dollars)

	Alternative A	Alternative B	Alternative C
Total Project Cost	3,823	3,623	4,140
Annual Cost (C)	189	178	204
Annual Benefits (B)	249	255	276
Annual Net Benefits (B–C)	61	77	72
Benefit-Cost Ratio (B/C)	1.32	1.43	1.35

Next Steps

The impacts of NODOS implementation are evaluated and potential mitigation measures are described in The Preliminary Administrative Draft EIR. DWR is not soliciting and will not respond to comments submitted on this PADEIR, although any comments received will be retained and may be considered during preparation of a future public draft EIR. DWR will work with the Legislature, Reclamation, and the Sites Project JPA to help facilitate a funding partnership in support of a financeable multi-benefit offstream storage project.



The following five documents associated with the NODOS Investigation will be available online at **http://www.water.ca.gov/storage:**

NODOS Investigation Highlights (this report) by DWR

NODOS Preliminary Administrative Draft EIR by DWR

NODOS Investigation 2013 Progress Report by Reclamation and DWR

NODOS Preliminary Design and Cost Estimate Report by DWR

NODOS Sensitivity Analysis of Operations with the BDCP Technical Memorandum by the Sites Project JPA

Any questions, contact: Sean Sou, DWR (916) 651-9269,
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California Department of Water Resources
1416 Ninth Street, Sacramento, CA 95814
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18 Principles for Water Conveyance in the Delta, Storage Systems, and for the Operation of Both to Achieve the Coequal Goals[1,2]

New or Improved Water Conveyance, Storage Systems, and the Operation of Conveyance and Storage is Needed Now. The Sacramento-San Joaquin Delta watershed and California's water infrastructure are in crisis and existing Delta policies are not sustainable. The current drought underscores this crisis. The Delta Plan includes a series of policies and recommendations intended to build regional self-sufficiency and reduce reliance on the Delta. However, regional actions alone will not be sufficient. After decades of study, decisions on conveyance, storage, and the operations of conveyance and storage need to be made promptly to further the coequal goals.

Delta Conveyance Principles

1. New or improved Delta conveyance infrastructure should enhance the Delta ecosystem, including restoring more natural flows, and increase the reliability that water available for export supplies can be exported.

2. Flexibility is key to new or improved Delta conveyance infrastructure. Conveyance improvements should be able to adapt to changing conditions (hydrology, climate change, and ecosystem needs) both near-term and in the future while continuing to provide benefits to the ecosystem and reliably convey available water supplies.

3. New or improved Delta conveyance infrastructure should increase resiliency of the state's water supply systems in the face of future threats related to climate change and levee failures due to sea level rise, more frequent flood events and earthquakes.

4. The benefits of new Delta conveyance infrastructure should be maximized by integrating with new and expanded storage projects, implementing projects that increase water-use efficiency and conservation, improving groundwater management, and restoring the structure and function of some key Delta ecosystems. New Delta conveyance infrastructure by itself does not create any new supplies of water.

Water Storage System Principles

5. New or expanded water storage projects above and below the Delta are necessary. They should enhance the ability to divert and store water during wet periods, contribute additional flows during dry periods, improve system flexibility to meet the coequal goals, and provide multiple additional benefits

such as flood control, recreation, or hydropower generation. Projects enhance the Delta ecosystem when they help better manage water quality and water temperature - especially during dry years, and when they increase the reliability of water supplies for wildlife refuges. Storing water in wet periods to use in dry periods also increases California's water supply reliability.

6. New or expanded storage projects should be cost effective. The amount of new storage that can be added to the system is limited by California's hydrology and topography. Smaller regional surface water storage projects and groundwater storage projects can sometimes provide significant benefits at a more affordable cost.

7. Groundwater storage opportunities should be protected. Groundwater basins in the Central Valley provide the largest amount of existing capacity to store excess flows from wet years. This capacity is threatened by land use decisions and by land subsidence caused by groundwater overdraft.

8. New or expanded storage projects should provide both immediate and enduring ecosystem and water supply benefits. Climate change and California's changing hydrology will challenge the ability for existing storage systems to maintain the level of benefits they currently provide.

9. New or expanded water storage projects are part of a system and should support a comprehensive approach to managing the water cycle. This also includes conjunctive management of rivers, groundwater, surface storage, floodplains, and wetlands that enhance groundwater recharge and improvements in regional water self-sufficiency.

Delta Water System Operational Principles

10. Water exported from the Delta should more closely match water supplies available to be exported. This should be based on water year type and consistent with the coequal goal of protecting, restoring, and enhancing the Delta ecosystem.

11. Storage and conveyance should be operated to provide more natural, functional flows to enhance Delta inflows and outflows by storing water in wet periods and reducing diversions in dry periods, consistent with the needs of the Delta ecosystem and water users.

12. Operational decisions should be based upon more accurate, timely, and transparent water accounting and budgeting.

13. Additional water supplies can be derived from more efficient reoperation of existing infrastructure.

14. Water storage operational guidelines should adopt a multi-year planning horizon to ensure adequate carryover of stored water in surface and groundwater reservoirs at the end of each water year to buffer against multiple dry years.

15. Surface and groundwater storage, whenever feasible, should be operated conjunctively to reduce long term groundwater basin overdraft and improve groundwater basin recharge.

16. Conveyance and storage infrastructure and their operation should provide real benefits to the ecosystem, in contrast to just protecting the ecosystem from further degradation.

17. Operation of storage and Delta conveyance infrastructure should be informed by best available science, adequately monitored and evaluated, and adaptively managed to ensure progress towards well-defined performance measures.

18. Ecosystem benefits should be assured through contracts, operations and governance protocols, or other enforceable agreements.

* * *

[1] Water Code section 85304 - The Delta Plan shall promote options for new and improved infrastructure relating to the water conveyance in the Delta, storage systems, and for the operation of both to achieve the coequal goals.

[2] Title 23 CCR 5001(h)(1)-(3) "Coequal goals" means the two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place. In addition, "achievement" for the purpose of determining whether a plan, program, or project meets the definition of a "covered action" under section 5001(j) is further defined as follows:

> (1) "Achieving the coequal goal of providing a more reliable water supply for California" means all of the following:
>
> > (A) Better matching the state's demands for reasonable and beneficial uses of water to the available water supply. This will be done by promoting, improving, investing in, and implementing projects and programs that improve the resiliency of the state's water systems, increase water efficiency and conservation, increase water recycling and use of advanced water technologies, improve groundwater management, expand storage, and improve Delta conveyance and operations. The evaluation of progress toward improving reliability will take into account the inherent variability in water demands and supplies across California;
> >
> > (B) Regions that use water from the Delta watershed will reduce their reliance on this water for reasonable and beneficial uses, and improve regional self-reliance, consistent with existing water rights and the State's area-of-origin statutes and Reasonable Use and Public Trust Doctrines. This will be done by improving, investing in, and implementing local and

regional projects and programs that increase water conservation and efficiency, increase water recycling and use of advanced water technologies, expand storage, improve groundwater management, and enhance regional coordination of local and regional water supply development efforts; and

(C) Water exported from the Delta will more closely match water supplies available to be exported, based on water year type and consistent with the coequal goal of protecting, restoring, and enhancing the Delta ecosystem. This will be done by improving conveyance in the Delta and expanding groundwater and surface storage both north and south of the Delta to optimize diversions in wet years when more water is available and conflicts with the ecosystem are less likely, and limit diversions in dry years when conflicts with the ecosystem are more likely. Delta water that is stored in wet years will be available for water users during dry years, when the limited amount of available water must remain in the Delta, making water deliveries more predictable and reliable. In addition, these improvements will decrease the vulnerability of Delta water supplies to disruption by natural disasters, such as, earthquakes, floods, and levee failures.

(2) "Achieving the coequal goal of protecting, restoring, and enhancing the Delta ecosystem" means successfully establishing a resilient, functioning estuary and surrounding terrestrial landscape capable of supporting viable populations of native resident and migratory species with diverse and biologically appropriate habitats, functional corridors, and ecosystem processes.

(3) "Achieving the coequal goals in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place" means accepting that change, including change associated with achieving the coequal goals, will not cease, but that the fundamental characteristics and values that contribute to the Delta's special qualities and that distinguish it from other places can be preserved and enhanced while accommodating these changes. In this regard, the following are core strategies for protecting and enhancing the unique values that distinguish the Delta and make it a special region:

(A) Designate the Delta as a special place worthy of national and state attention;

(B) Plan to protect the Delta's lands and communities;

(C) Maintain Delta agriculture as a primary land use, a food source, a key economic sector, and a way of life;

(D) Encourage recreation and tourism that allow visitors to enjoy and appreciate the Delta and that contribute to its economy;

(E) Sustain a vital Delta economy that includes a mix of agriculture, tourism, recreation, related industries and business, and vital components of state and regional infrastructure; and

(F) Reduce flood and other risks to people, property, and other interests in the Delta.

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July 29, 2014

To: Bay Delta Conservation Plan
responsible state and federal resource agencies

From: Save the California Delta Alliance

Comments on the Draft Bay Delta Conservation Plan
Comments on the Draft Environmental Impact Statement / Environmental Impact Report
Comments on the Draft Implementation Agreement

These comments are submitted on behalf of the Save the California Delta Alliance ("STCDA"). STCDA is headquartered in Discovery Bay, California. STCDA represents the interests of individuals who live and work in the Delta, including those with waterfront homes located in Discovery Bay, Delta related businesses, and many who engage in all kinds of water-related recreation in the Delta. STCDA regularly turns out several hundred enthusiastic members at it its town hall style meetings held in Discovery Bay.

These comments address the Draft Bay Delta Conservation Plan, the Draft Environmental Impact Statement / Environmental Impact Report, and the Draft Implementation Agreement.

References cited herein and attached hereto (and hereby made a part of the administrative record for the BDCP and EIR/EIS) are listed in Appendix 1 hereto.

Thank you for the opportunity to submit these comments and for considering our views.

I. The Project Area In The BDCP and The Project Objectives / Purpose In The EIR/EIS Are Defined In Unreasonably Narrow Terms Frustrating Consideration Of A Reasonable Range Of Alternatives.

The EIR/EIS ("EIR") does not consider broad alternatives or compliments to the twin tunnels. For example, although virtually all sides in the California water debate agree that some form of additional storage is a necessary component of any long-term solution, the EIR does not consider any alternatives that include storage options. Likewise, the Public Draft Bay Delta Conservation Plan ("BDCP") does not include any storage components. Nor does the BDCP include actions outside the narrow geographic scope defined in the Plan Area, which is the statutory Delta and several immediately adjacent areas. *See* BDCP § 1.4.1.

A significant justification for the twin tunnels has been the "little sip, big gulp" rationale. Although this seems to have fallen by the wayside in BDCP promotional efforts

of late, it still accurately describes the best policy rationale for the tunnels. By relocating the point of diversion and providing large capacity conveyance it would be possible to draw larger quantities of water at times of abundance (big gulp) thereby allowing diversions to be minimized at times of low flow and critical environmental need (little sip). Sounds good. But it doesn't work without storage. Although the tunnels would provide the ability to divert large quantities of water during peak winter flows, there is currently nowhere to store such diversions. The legislature has ordained that it is state policy to "[i]mprove the water conveyance system and expand statewide water storage." Cal. Water Code § 85020(f). It is no accident that storage and conveyance are tightly yoked in legislative policy. Only with the provision of additional storage capacity can the tunnels actually function as a big gulp little sip device. Yet the BDCP does not contain any storage, and the EIR does not analyze a "tunnels plus storage" alternative.

The feasibility and benefits of expanding storage through increased groundwater recharge is beyond dispute. The necessity to provide additional storage and feasibility of doing so is discussed in more detail in section II below.

The project proponents have attempted to insulate the failure to consider storage and other defects in the BDCP and EIR from challenge by narrowly defining the Project Objectives/Purpose in the EIR and geographic scope in the BDCP. *See* EIR ES.2; BDCP § 1.4.1. However, "a lead agency may not give a project's purpose an artificially narrow definition" in order to arrive at its own foreordained result. *In Re Bay–Delta Programmatic Envtl. Impact Report Coordinated Proceedings*, 43 Cal. 4th 1143, 1166 (2008). An "agency cannot define its objectives in unreasonably narrow terms." *City of Carmel-By-The-Sea v. U.S. Dept. of Transp*, 123 F.3d 1142, 1155 (9th Cir.1997). "Instead, agencies must look hard at the factors relevant to the definition of purpose … . Once an agency has considered the relevant factors, it must define goals for its action that fall somewhere within the range of reasonable choices." *Citizens Against Burlington, Inc. v. Busey*, 938 F.2d 190, 196 (9th Cir. 1991).

The Project Objectives provide that a project objective is the "construction and operation of facilities … for the movement of water entering the Delta from the Sacramento Valley watershed to the existing SWP and CVP pumping plants located in the southern Delta." EIR ES-9. This, however, is simply a definition of the twin tunnels. That is an *end result* of the decisional process, not a valid project objective. The project proponents have simply crafted a definition of Project Objectives so narrow that the only result can be to fulfill their own twin tunnel prophecy. However:

> We realize, as we stated before, that the word "reasonable" is not self-defining. Deference, however, does not mean dormancy, and the rule of reason does not give agencies license to fulfill their own prophecies, whatever the parochial impulses that drive them. Environmental impact statements take time and cost money. Yet an agency may not define the objectives of its action in terms so unreasonably narrow that only one alternative from among the environmentally benign ones in the agency's power would accomplish the goals of the agency's action, and the EIS would become a foreordained formality.

Citizens Against Burlington, Inc. v. Busey, 938 F.2d at 196.

The actual purpose of the project is to provide regulatory stability to the operation of the entirety of the state and federal water projects while at the same time lessening and/or mitigating the impact of the operation of the water projects on Delta ecology, and increasing water deliveries with the goal of attaining full contract amounts. These are extraordinarily broad-based policy goals. However, the "Project Objectives" and "Project Purpose" sections in the EIR have been drafted with exceeding precision and care, likely involving many attorney hours in the crafting of these few paragraphs, to limit the range of actions that would fulfill the Project Purpose and Objectives to improving conveyance from the north Delta to the existing export pumps, and providing habitat within the statutory Delta and adjacent areas. *See* EIR ES.2.

The Project Purpose and Project Objectives sections, however, are radically under-inclusive of the actual purposes, as betrayed repeatedly throughout the text of the BDCP: "The overarching goals of the BDCP are to advance the restoration of the ecological functions and productivity in the Delta and restore and protect water supplies provided by the SWP and CVP … ." BDCP 1-5. Successful completion of the BDCP is intended to "afford regulatory stability with respect to the operation of the primary water delivery systems for the State of California." BDCP 1-26. The BDCP "is intended to result in long-term regulatory stability for the state and federal water projects, while furthering the goals of the BDCP to restore and protect ecosystem health, water supply, and water quality." BDCP 1-6. *See also* Draft Implementing Agreement for the Bay Delta Conservation Plan § 2.1.8 ("The overall goal of the BDCP is to restore and protect ecosystem health, water supply, and water quality within a stable regulatory framework.") ("IA").

Surely if the actual goals are to provide regulatory stability for the entire state and federal water projects, protect the drinking water supply and quality for 19,000,000 Californians and millions of acres of irrigated agriculture, and restore the ecosystem health of the largest estuary on the west coast of north America then it is irrational to provide a legal description of those goals in terms so narrow that possible alternatives are limited to exclude almost all components of the state and federal water projects, exclude storage, exclude conservation, and exclude solutions that actually address the problem.

The artificial and impermissible segmenting of Biological Opinions is another attempt to insulate broad effects of the project from challenge by narrowing its legal scope in a way that is inconsistent with its actual scope. BDCP section 1.3.2.2 provides:

> With respect to Reclamation's operation of the CVP, the joint BiOp for the BDCP will cover only those operations that occur after the new water conveyance facilities are operational which is expected to be in 2026. At that time, the joint BDCP BiOp is expected to supersede the existing BiOps (as revised) for the coordinated long-term operation of the SWP and CVP, but only for those operations that occur within the Plan Area. The BiOps on the coordinated long-term operation of the SWP and CVP are expected to continue to provide Section 7 Authorization for operations of the SWP and CVP that occur outside of the BDCP Plan Area.

BDCP 1-9. This segmenting is inconsistent with the fact that "[t]he infrastructure of the state and federal water projects form an integrated system that extends beyond the boundaries of the Delta [and BDCP project area]; as such, the BDCP will affect water operations, species, and habitat both inside and outside the Delta." BDCP 1-3.

For all its discussion of the importance of scale within the fledgling science of restoration ecology, the BDCP does not blush at turning a blind eye to scale when embracing the true dimensions of an issue becomes an impediment to breaking ground on tunnel construction.

II. The BDCP Should Be Revised To Include Storage Through Groundwater Recharge And The EIR Should Analyze A Reasonable Range Of Alternatives That Include Storage Through Groundwater Recharge.

The recently completed Delta Plan, promulgated after years of study and at the charge of the Legislature to set state policy for the Delta, concluded that the key to restoring the health of the Delta and providing a reliable water supply for the state is "Storing Floods to Ride Out Droughts (and Give the Delta a Break)." Delta Plan ES-6. As the Delta Plan is critical to informed decision making for the BDCP and for consideration of a reasonable range of alternatives for the EIR, it is attached in its entirety and made a part of these comments and the administrative record. The Delta Plan further found that groundwater recharge is the best way to achieve additional storage capacity: "using aquifers like bank accounts: to be filled up in wet times, in order that they may be drawn from in dry." Delta Plan ES-7.

A critique of the BDCP by an eminent panel of scientists, commissioned by American Rivers and the Nature Conservancy, Saracino & Mount, LLC, Panel Review of the Draft Bay Delta Plan Prepared for the Nature Conservancy and American Rivers ("Mount Report") also concluded that although one of the objectives of the BDCP is "to increase exports during wet periods and decrease them during dry periods … it does not significantly reduce pressure on the Delta during drier periods." Mount Report 30. The Mount Report suggested that "Expanding potential storage, particularly groundwater storage, would have created considerably more flexibility in exports" allowing more water to be harvested in wet years (big gulp) and conserving environmental flows during periods of scarcity (little sip). Mount Report 22. The Mount Report is attached in its entirety and made a part of these comments and the administrative record.

In Research Brief Issue #102, *Does California Have the Water to Support Population Growth ?* The Public Policy Institute of California Concluded that groundwater storage can provide an additional two million acre feet of "new" water per year. (Attachment ___). Moreover, increasing groundwater storage is the official policy of the state of California. The California Water Plan Update 2005 estimated that through groundwater banking there is "the potential to increase average annual water deliveries by 2 million acre-feet" in conjunction with reoperation of existing surface water reservoirs. California Water Plan Update Chapter 4, page 4-2.

In the report, Groundwater Availability of the Central Valley Aquifer, published by the USGS ("Groundwater Availability"), the authors discuss water banking through groundwater recharge generally and the new groundwater recharge water bank, the Madera Ranch Project, that "would divert floodwaters from the Delta" for storage and

future use. Groundwater Availability 108. The Madera Ranch Project involves the banking of CVP water in collaboration between the Madera Irrigation District, A CVP water contractor, and the USBR, a close collaborator on the BDCP. The parties to the BDCP have it well within their means to use additional groundwater banking as a component of the BDCP and it is proven feasible to bank CVP water in groundwater recharge throughout the state.

Groundwater Availability is designed to "be used to identify favorable locations [for groundwater recharge] on a regional scale" and should be of use to BDCP planners in evaluating alternatives that build on the Madera Ranch model. *Id*. Attached are the Madera Ranch federal Record of Decision and Environmental Impact Statement for use in considering additional groundwater banking as an integral component of the BDCP and as part of a reasonable range of alternatives. Also attached are the following scientific reports on groundwater recharge for use in developing alternatives, as listed in Appendix 1.

There is scientific consensus that additional storage through groundwater banking is an essential and feasible element in addressing California's water supply issues and in restoring the health of the Delta. Since these are the two actual goals of the BDCP, there is no reason why groundwater banking should not be a part of the BDCP and failure to consider an alternative that includes groundwater storage is failure to consider a reasonable range of alternatives.

The artificial narrowing of possibilities for infrastructure to exclude groundwater recharge by limiting conveyance to the tunnels and the project area to the Delta by way of an inapt Project Objectives section is no bar to real solutions. Instead, the BDCP proponents "must look hard at the factors relevant to the definition of purpose … . Once an agency has considered the relevant factors, it must define goals for its action that fall somewhere within the range of reasonable choices." *Citizens Against Burlington, Inc. v. Busey*, 938 F.2d 190, 196 (9th Cir. 1991). Here, the range of reasonable choices must include storage, and any reasonable consideration of storage must include groundwater banking.

Investment in infrastructure throughout California to accomplish groundwater recharge is well within the range of reasonable choices available to the BDCP. The water contractor proponents of the BDCP have much of the state's groundwater resources under their collective purview. The water contractors have participated successfully in construction of regional groundwater banking facilities and with USBR in groundwater banking CVP water. As noted in the Delta Plan:

> Statewide water storage capacity, both above and below ground, is currently inadequate, especially south of the Delta, to facilitate export of water at times of surplus when the impacts on the Delta's ecosystem are reduced and the only impediment is lack of available storage capacity (DWR 2009). For example, in 2010, the SWP and CVP pump operations were slowed even though water was available to be pumped at a time when it would not have conflicted with endangered species or other water quality requirements. The SWP and CVP could not convey the surplus water through the Delta at that time because storage capacity south of the Delta was full.

Delta Plan 86.

How much "new" water could be harvested from the existing pumps if lack of storage was addressed through provision of groundwater banking facilities? Construction of the tunnels will cause massive disruption of life in the Delta. The stretch of the Sacramento River and adjacent farmland between Clarksburg and Walnut Grove will be transformed from a peaceful boating and farming landscape into a vast industrial complex supporting tunnel infrastructure. The tens of billions of dollars involved in tunnel construction might be better spent on a series of smaller groundwater recharge projects that would be much less locally disruptive, spare Delta communities from annihilation, and would actually achieve the goals of providing a more reliable water supply to the state, restoring the Bay-Delta ecosystem, and expanding statewide storage capacity as mandated by the legislature.

Or, perhaps, a smaller tunnel project in conjunction with additional storage would be the optimal solution. We will not know until the proponents of the BDCP roll up their sleeves and analyze a reasonable range of storage alternatives—not limited by an artificially narrow project description.

III. The BDCP Should Be Revised To Include Storage / Management With The Sites Reservoir As An Integral Component And The EIR Should Analyze Alternatives Including Sites Reservoir As An Integral Component Of The BDCP.

The proposed Sites Reservoir project, also known as North of Delta Offstream Storage ("NODOS") is well along in planning and analysis. A preliminary draft environmental impact report and preliminary engineering design were completed in May 2014. Technical difficulties prevented download and inclusion of these documents herewith. They are incorporated by reference and will be provided under separate cover. They are available at http://www.water.ca.gov/storage/northdelta/index.cfm. A technical Memorandum, Sensitivity Analysis of Operation with the BDCP, has not yet been released to the public. The technical memorandum, however, should be currently available to the resource agencies and it is incorporated into the administrative record by reference now even though it is not available to be attached hereto.

NODOS would operate by diverting flows from the Sacramento River at times of high flow through a series of existing irrigation canals to a new surface storage facility. The stored water would then be released back to the river during periods of scarcity. NODOS is well upstream of the Delta, and water released from NODOS could be allocated between in-stream environmental needs and export needs. NODOS could operate in conjunction with any new or existing point of diversion in the Delta, including the tunnels.

NODOS is projected to store up to 1.4 million acre feet. This would add considerable flexibility (which the Mount Report found lacking) to the BDCP for both water supply and environmental needs. The logic of incorporating Sites into the BDCP is obvious. Its technical development has been coterminous with the BDCP. Its function, is to bring to fruition the little sip big gulp approach sorely lacking in the BDCP.

Failure to analyze an alternative that includes Sites makes the range of alternatives analyzed by the BDCP unreasonable. Incorporating Sites would allow the BDCP to become what it must be in order to be successful, a system that can "Store[] Floods to Ride Out Droughts." Delta Plan ES-6.

IV. The BDCP Should Store Floods To Ride Out Droughts.

As currently formulated, the BDCP fails the basic test for providing water supply and environmental solutions because it is a run-of-the-river project. It fails to comply with the coequal goals of the Delta Reform Act, "providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem." Cal. Water Code § 85054. Instead, it must continue to rob environmental needs of water at times of scarcity in order to provide water supply. As such, it simply continues the basic problem rather than offering any solution. The problem, in a nutshell, is that there is an overabundance of water that comes all at once, at the wrong time, in the wrong place, and erratically.

Winter storms drop tremendous amounts of water in very short periods and there is currently no way to harvest or store this water. Instead, it is diverted through flood control structures around the Delta and out to sea.

Attached is a DWR fact sheet entitled Sacramento River Flood Control Project Weirs and Flood Relief Structures. It shows historical diversions at the Moulton, Colusa, Tisdale, Fremont, and Sacramento Weirs. These weirs have combined capacity to divert 588,000 cfs. The Sacramento Weir alone, operating at a river stage of 31 feet, diverts over 31,000 cfs. To put this into perspective, that would be 1 MAF approximately every 16 hours, or the equivalent of the high end of total SWP and CVP yearly diversions (6 MAF) in a period of 4 days. From just one of the five weirs.

The BDCP proposes to spend tens of billions of dollars on new water supply infrastructure. Yet no alternative that would harvest and store even a fraction of this abundance is considered.

V. Issuance Of ESA Permits Is Not A Valid Project Objective And Mis-describes The Project.

The stated objective of "[r]espond[ing] to the application for ITPs for the covered species that authorize take," EIR, ES-8, is not a lawfully permissible project objective or purpose. STCDA first pointed out the confusion around what the project actually is in its comments dated November 16, 2011. Our November 16, 2011, comments are attached and incorporated in full here as to project objectives and purpose and all the other issues raised therein. As we pointed out in those comments, the February 13, 2009, Notice of Intent to prepare an Environmental Impact Statement, 74 Fed. Reg. 7257 ("NOI") states that the proposed federal actions are issuance of ESA permits and implementation of one or more components of the BDCP. However that is not correct. The major federal action is the continued operation of the CVP at increased rates of export through implementation of conveyance improvements/alterations.

See Delta Smelt Consol. Cases, 686 F. Supp. 2d 1026, 1042 (E.D. Cal. 2009) (major federal action was not the issuance of biological opinions but rather "planned coordinated operation of the Projects [CVP] that creates the jeopardy found by the BiOp."). *See also* U.S. Fish & Wildlife Service, *Habitat Conservation Plans*, *available at http://library.fws.gov/Pubs9/hcp_section10.pdf* (last visited Nov. 14, 2011) (noting that "[t]he purpose of the incidental take permit is to authorize the incidental take of a listed species, not to authorize the activities that result in the take").

The mis-description of the project in the NOI and Project Objectives section of the EIR are part and parcel of the attempt to portray the tunnels as a "conservation measure" and/or integral part of a habitat conservation plan. The tunnels are a piece of water supply infrastructure. They are an operationally indivisible part of the system that *causes* the take. The vast habitat restoration projects are *mitigation* for operation of the tunnels/CVP/SWP.

The BDCP's pervasive attempts to disguise as a habitat conservation plan a project aimed at increasing water exports through construction of large capacity conveyance facilities violates the Endangered Species Act and numerous other state and federal laws, including the federal Information Quality Act. The attempt to disguise and dissemble also means that the BDCP EIR/EIS fails to provide a stable and accurate project description, in violation of CEQA and NEPA. Rather than foster informed public participation, which is at the heart of CEQA and NEPA, the overly-clever scheme to disseminate misinformation about the true nature of the project is a wanton and willful violation of CEQA and NEPA.

A major Project Objective is to "[r]estore and protect the ability of the SWP and CVP to deliver up to full contract amounts" of water as stated in water delivery contracts. EIR ES-8. The SWP and CVP have never been capable of delivering full contract amounts. Environmental consequences of such delivery and the fact that Delta water is vastly oversubscribed have made such exports impossible. Yet, the tunnels, which would make such vastly increased exports possible, are described as a conservation measure. And the project, including the objective of doubling or tripling water exports, is denominated as a habitat conservation plan. Vastly increasing water exports has nothing to do with conserving habitat or arresting the decline of species.

The two key quantitative guardians of maintaining in-stream flow necessary for environmental protection, X-2 and spring outflow, are made subject to manipulation in order to "minimize water supply effects." BDCP 3.4-11. In other words, the BDCP is a plan to shift water from environmental application to export.

To meet the requirements of state and federal law, the project must be accurately portrayed as a water supply project with attendant habitat restoration as mitigation. As currently formulated, the BDCP is not a Habitat Conservation Plan, within the meaning of the federal Endangered Species Act.

VI. The BDCP Fails To Comply With Water Code Section 85321

California Water Code section 85321 provides that:

> The BDCP shall include a transparent, real-time operational decision-making process in which fishery agencies ensure that applicable biological performance measures are achieved in a timely manner with respect to water system operations.

The intent of the legislature was that real-time decision-making would "ensure that applicable biological performance measures are achieved in a timely manner." However, BDCP section 3.4.1.4.5 employs real-time decision-making as a way of maximizing water exports:

> The CM1 real-time operational decision-making process (real-time operations [RTOs]) allows for short-term adjustments in operations within the range of CM1 criteria described above in Section 3.4.1.4.3, *Flow Criteria*, in order to maximize water supply for SWP and CVP relative to the Annual Operating Plan and its quarterly updates subject to providing the necessary protections for covered species.

BDCP 3.4-26. Species are an afterthought in the BDCP's version of real time operations. They were the *only* concern of the legislature in its specification of real time operations. The legislature said *nothing* about using real-time operations to maximize water supply or adjust the Annual Operating plan.

The BDCP further lists the factors to be considered in adjusting real-time operations as "Covered fish species risks; Necessary actions to avoid adverse effects on covered fish species; Allocations in the year of action or in future years; End of water year storage; San Luis Reservoir low point; Delivery schedules for any SWP or CVP contractor; Actions that could be implemented throughout the year to recover any water supplies reduced by actions taken by the RTO team." BDCP 3.4-26–27. This further emphasis on operation of the tunnels as a water supply device simply confirms the obvious that the tunnels are a water supply device; they are not a conservation measure; nor are they properly described as part of a Habitat Conservation Plan.

All real-time operations adjustments are further strictly limited in that they cannot override the bypass flow criteria established in the BDCP. In other words, no matter what, the water contractors are entitled to receive water in the range permitted by the bypass flow criteria. Real time operations cannot reduce exports beyond these levels. *See* BDCP Chapter 3.4.1.4 and IA § 10.2.2.3. That is not what the legislature ordained. Pasting this additional guarantee of water deliveries into real-time operations that were intended to "ensure that applicable biological performance measures are achieved in a timely manner with respect to water system operations" is contrary to the legislative intent and directive.

To be sure, consistent with its penchant for providing result-oriented legal descriptions that endorse its predetermined course of conduct, the BDCP declares that "[t]he RTO's will satisfy Water Code, section 85321." BDCP 34-26. But saying doesn't make it so. Particularly when no analysis or reasoning is provided as to how, given the glaring disparities described above, the BDCP RTOs satisfy section 85321. Moreover, this one-sentence feat of statutory interpretation, along with the other criteria provided in the BDCP to "implement" section 85321, is an illegal underground regulation with respect to DWR and CDFW. *See* section IV of these comments below.

The Draft IA proffers CDFW's finding that the BDCP complies with section 85321. IA § 4.2.2. However, the drafters have misread the Water Code. Section 85320 is within CDFW's purview (although with limited effect and subject to appeal). Section 85321 is not within CDFW's purview at all. The legislature charged a different state agency (the Delta Stewardship Council) with adjudging in the first instance whether the BDCP complies with section 85321.

VII. The BDCP Lacks Effective Adaptive Management Capability.

Despite the lavish attention paid to general concepts of adaptive management and the celebration of adaptive management as essential to any hope of success of the project, adaptive management is effectively hobbled with respect to the variable most crucial to the success of the plan: water exports.

The IA provides that any "change to a Conservation Measure in a manner that would potentially result in the modification of water supplies [must be] consistent with Section 9.3.7" of the IA. "9.3.7" appears to be a typo and should read 10.3.7. Section 10.3.7, in turn, provides that the "limits and constraints" on adjusting water operations through adaptive management "are set out in Chapter 3.4 and Chapter 8." Chapter 3.4, in turn, contains all the flow criteria, including bypass flows, that have been ardently negotiated into the agreement by the water contractors. Thus, adaptive management is no more available to reduce exports below the flow criteria set out in BDCP section 3.4.1.4.3 than is real time management.

Under withering public criticism, state and federal officials finally backed down from previous agreements (in prior drafts of the BDCP) extracted by the water contractors that reductions in guaranteed levels of exports could only be accomplished through a years-long appeal process that ultimately had to be decided by the Secretaries of the Interior and Commerce and Governor of California (virtually assuring that exports would never be reduced). However, in yet another glaring example of regulatory capture, the water contractors appear to have *improved* their position in the latest BDCP draft.

Under regulatory assurances, the IA specifies that "quantity and timing of [water] delivery" may not be altered under the no surprises rule, and additional measures required of the water contractors to address emergent circumstances may not involve "resource restrictions." IA § 14.1.

By providing an exhaustive list of what constitutes changed circumstances in BDCP section 6.4.2, the BDCP insulates the water contractors from reductions in water exports under the no surprises rule for anything that is not listed. Glaringly absent from the list is the simple proposition that the BDCP will simply not work as projected. Much of the BDCP can, most charitably, be described as at the frontier of scientific knowledge.

The BDCP assumes that wetland creation on farmland that has been reclaimed for over a hundred years and has subsided dozens of feet will be wildly successful. This, despite the fact that no wetland creation in similar circumstances has ever been attempted. It assumes that changes in the point of diversion will achieve all hoped for benefits. None of this is proven from experience. All BDCP projections rely on modeling. And as every good scientist knows, all models are wrong but some models are useful. To make the BDCP models useful to species recovery (rather than lethal to it), the list of changed circumstances should be amended to include "any component of the BDCP not performing as projected," and "jeopardy to any species.

Calling the tunnels a conservation measure has lead to a perversion of the Endangered Species Act whereby the largest single stressor to endangered species, water exports, are guaranteed against reduction (even if reduction is needed to assure species recovery) by the no surprises rule. The ESA and HCP here function as a guarantors of economic benefit to the water contractors and not as tools of species recovery. This is not what Congress intended in enacting the ESA and allowing for HCPs.

If it was not the intent of the state and federal resource agencies to guarantee export levels no matter what, the IA and BDCP should be amended to include the following: "Nothing herein, including but not limited to section 3.4.1.4.3 of the BDCP and section 14.1 of the IA, shall limit or constrain any reduction in water exports determined to be appropriate to achieve the biological goals and objectives through the adaptive management process."

VIII. Along With Much Of The BDCP, DWR's Interpretation Of Section 85321 And Promulgation Of Implementing Criteria Are Illegal Underground Regulations.

California Government Code section 11342.600 provides:

> "Regulation" means every rule, regulation, order, or standard of general application or the amendment, supplement, or revision of any rule, regulation, order, or standard adopted by any state agency to implement, interpret, or make specific the law enforced or administered by it, or to govern its procedure.

California Government Code section 11340.5 in turn provides in pertinent part:

> No state agency shall issue, utilize, enforce, or attempt to enforce any guideline, criterion, bulletin, manual, instruction, order, standard of general application, or other rule, which is a regulation as defined in Section 11342.600, unless the guideline, criterion, bulletin, manual, instruction, order, standard of general application, or other rule has been adopted as a regulation and filed with the Secretary of State pursuant to this chapter.

These provisions of the California Administrative Procedure Act ("APA") apply to the BDCP. The BDCP implements, interprets, and makes specific numerous state laws, including the Delta Reform Act. "The provisions of the BDCP were developed to satisfy the requirements of the Sacramento-San Joaquin Delta Reform Act of 2009, California Water Code (Water Code) § 85300 *et seq*." IA 2.1-9.

The criteria promulgated to implement Water Code section 85321, as discussed in section III of these comments above, are regulations within the meaning of the APA. The criteria selected and the statutory interpretation involved therein (for example, that real time operations cannot override pre-established flow criteria) are subject to the APA. "Absent an express exception, the APA applies to *all* generally applicable administrative interpretations of a statute." *Morning Star Co., v. State Bd, of Equalization*, 38 Cal. 4th 324, 335 (2006) (emphasis added). The sole exception, that the agency's interpretation is "the only legally tenable interpretation of a provision of law,' Cal. Gov. Code § 11340.9(f) cannot apply here. The "lone 'legally tenable' reading of the law applies only in situations where the law can reasonably be read only one way." *Morning Star Co.,* 38 Cal. 4th at 337. Only where "the agency's actions or decisions in applying the law are essentially rote, ministerial, or otherwise patently compelled by, or repetitive of, the statute's plain language," does the exception apply. *Morningstar, 38 Cal. 4th at 336*. The interpretation and implementation of section 85321 here involves an exercise of discretion as to how the statute will be applied. The choices made are by no means the only ones possible under the statute.

The BDCP is not limited to a single project but rather is of general application to an entire class of cases and projects: the BDCP's designated "Covered Activities." This is acknowledged by the parties to the BDCP: The BDCP "[s]ets out a comprehensive approach to coordinating and standardizing applicable requirements for Covered Activities and Associated Federal Actions within the Plan Area." IA 3**.** The BDCP "[e]stablishes a more efficient and effective approach to regulatory compliance with State and federal endangered species laws than through project-by-project, species-by-species planning." Draft Implementing Agreement for the Bay Delta Conservation Plan § 2.1.8.

Where implementation or interpretations "apply generally, rather than in a specific case" the rulemaking provisions of the APA apply. *Morning Star Co., v. State Bd, of Equalization*, 38 Cal. 4th 324, 334 (2006).

The Biological Goals and Objectives and performance standards are further examples of regulations. "'Performance standard' means a regulation that describes an objective with the criteria stated for achieving the objective." Cal Gov. Code § 11342.570.

The BDCP is of monumental public interest and importance, essentially governing the operation of the state's water supply infrastructure and managing the Delta's biological resources over the next fifty years. DWR and CDFW may believe that operating the SWP and managing Delta resources are a matters of internally managing their own infrastructure and not therefore subject to the APA. However, matters "of serious consequence involving an important public interest" cannot escape the requirements of the APA on grounds that the agency is simply determining how it will handle its own internal affairs. *City of San Marcos v. Cal. Highway Com.,* 60 Cal. App. 3d 383, 408 (1976).

By way of further example, CDFW has engaged in underground rulemaking by promulgating section 9.5 of the Draft IA, which specifies procedures and standards of future general application for evaluating "Approval, Adoption or Amendment of Future Plans or Projects," which could result in suspension or revocation of state permits; section 11.1.2, which specifies procedures for "Addressing Failure to Maintain Rough Proportionality."

The instances of underground rulemaking in the BDCP are too numerous and extensive to be exhaustively listed here. Wherever the BDCP implements, interprets, or makes specific state law for general future application, that exercise must comply with the APA.

IX. USFWS And NMFS Have Engaged In Disguised Negotiated Rulemaking With The Water Contractors In Violation Of The Administrative Procedure Act And The Negotiated Rulemaking Act.

All rules issued by federal agencies are subject to the requirements of the federal Administrative Procedure Act. A rule is defined as "an agency statement of general or particular applicability and future effect designed to implement, interpret, or prescribe law or policy or describing the organization, procedure, or practice requirements of an agency" in carrying out its functions. 5 U.S.C. § 551(4). All rules promulgated by federal agencies are subject to notice and comment requirements and publication in the Federal Register, not met here. Further requirements are imposed by federal law on "negotiated rulemaking" whereby federal agencies negotiate, as here, the outcome of the rulemaking process with affected entities. *See generally* the Negotiated Rulemaking Act of 1990, the Federal Advisory Committee Act.

The BDCP and Draft IA contain numerous binding pronouncements of the federal agencies of both general and particular applicability and future effect designed to implement and interpret numerous federal statutes, including the Endangered Species Act, the Fish and Wildlife Coordination Act, the Fish and Wildlife Act of 1956, and the Central Valley Improvement Act. These commitments have been arrived at through negotiation with the Water Contractors. As such, both the BDCP and IA are subject to the Administrative Procedure Act, the Negotiated Rulemaking Act, and the Federal Advisory Committee Act.

Indeed, the entire "adaptive management" component of the BDCP was arrived at through disguised negotiated rulemaking and specifies little more than a procedure for future disguised negotiated rulemaking, intended to subvert the requirements of federal law.

Section 10.2.1.3 of the IA acknowledges that specific outflow criteria are integral to the issuance of take permits. However, it further provides that the outflow criteria may be altered by following a process outlined in section 10.2.1.2, without amending the permits. Likewise, section 10.3.6 specifies that a Conservation Measure or a biological objective may be changed through the adaptive management process set out in section 10.3 of the IA without amending the BDCP or any incidental take permit or other regulatory authorization. First, this is unlawful in any event as permit conditions cannot be altered except by amending the permit. Second, specifying a procedure and

substantive criteria that are to be used, and the agency is legally committed to using, in order to alter the terms of permits it issues or to alter the terms of the BDCP is an "agency statement of general or particular applicability and future effect" within the meaning of 5 U.S.C. § 551(4).

Moreover, the parties seem blind to the fact, even if the adaptive management process could be used in the way intended by the IA, that each such change would be subject to environmental review pursuant to NEPA and CEQA.

The management of outflow criteria, the amount of freshwater that flows from the Delta into San Francisco Bay and the Pacific Ocean, is of monumental scope and public importance. The federal agencies have bound themselves to future conduct with respect to their responsibilities in this regard. Section 10.2.1.4 further limits the discretion of the federal agencies to act with regard to outflow through the adaptive management process of the BDCP.

X. The BDCP and Draft IA Violate The Delta Reform Act Because They Contain No Provisions Providing For A Statewide Reduction In Reliance On Delta Water Supplies.

The Draft IA acknowledges that the BDCP must comply with the Delta Reform Act of 2009. Draft IA § 4.2.2. However, the BDCP and IA entirely overlook the Delta Reform Act mandate that "[t]he policy of the State of California is to reduce reliance on the Delta in meeting California's future water needs" through regional self-sufficiency. The pervasive preoccupation with finding a path to reduce outflow criteria conflicts with state policy to reduce reliance on the Delta. Rather it is a formula to reduce water committed to environmental needs so more water can be exported from the Delta and reliance on Delta water can be increased.

XI. The BDCP Lacks Required Assurances of Adequate Funding.

The BDCP relies on funding from new state water bonds, yet to be approved by the legislature for placement on the ballot and of uncertain fate with the voters if placed on the ballot. The water bond described in section 8.3.5.1 is, at best, a political football in the state legislature and likely to contain provisions that bar use of any funds for anything related to the BDCP. Several legislators have announced intentions to place such restrictions on the water bond. The statement that "[t]he BDCP is expected to secure a large portion of the funds allocated [by the new water bond] to Delta sustainability as well as smaller portions of funds allocated to conservation and watershed protection" is at best wishful thinking.

The BDCP's reliance on the use of funds from existing water bonds, already approved, is subject to legal challenge as the monies designated by these bonds were not approved by the voters for construction of the BDCP.

As to federal funding, the BDCP acknowledges that "new federal appropriations would be needed to support the BDCP." BDCP § 8.3.6. A wish that Congress will appropriate funds, or the intent to request funds for your pet project, is not an assurance of adequate funding within the meaning of state and federal law.

The IA statement that "there is no federal position as of this time regarding potential funding obligations of the United States," IA § 13.1.2, is accurate. However, the IA's statement that "[t]he parties anticipate reaching agreement on a federal" share of funding seems blissfully ignorant of the fact that "No Money shall be drawn from the Treasury, but in Consequence of Appropriations made by Law." U.S. Const. Art. 1, Sec. 9, cl. 7. Until appropriated by Congress, federal funding is not assured.

XII. Impacts on Discovery Bay Are Not Analyzed In The EIR And The BDCP Lacks Adequate Monitoring For Discovery Bay.

Representatives from Discovery Bay have requested at BDCP public meetings and through other channels that specific analysis of the project's water quality impacts on Discovery Bay be included in the Draft EIR/EIS. They have not been included. Discovery Bay is different than the rest of the Delta. It consists of 16 shallow water bays, ranging in size from less than an acre to several acres. There is little circulation in the bays. The impacts on water quality in nearby open water sloughs and channels do not translate to water quality impacts in the bays, where reduction in high quality fresh water will translate to much greater degradation of water quality. In order to adequately assess the impacts of the project on water quality in Discovery Bay it will be necessary to perform a fine grain RMA or other analysis of the specific impacts on Discovery Bay. The EIR/EIS fails to adequately address water quality impacts in Discovery Bay.

The EIR/EIS also fails to adequately take account of existing and expected baseline conditions for Discovery Bay and other areas of the Delta where invasive aquatic weeds have significantly hampered circulation and degraded water quality. The weeds result in algal blooms and dangerous reductions in dissolved oxygen. Planned operational changes to the cross-Delta gates, which supply high quality water to the central Delta, including Discovery Bay, must be analyzed at a fine grain level with respect to Discovery Bay and taking account of weed infested baseline conditions.

The mitigation and monitoring/adaptive management program lacks monitoring specific to Discovery Bay. Nearby monitoring stations in open water are inadequate to capture conditions in the sheltered bays.

Submitted,

s/Michael A. Brodsky
Michael A. Brodsky

APPENDIX 1 TO STCDA BDCP COMMENTS

Natural Heritage Institute. “Designing Successful Groundwater Banking Programs in the Central Valley”. 2000

Natural Heritage Institute. “Estimating the Potential for In-Lieu Conjunctive Water Management in the Central Valley”

Natural Heritage Institute. “The Hydrogeological Suitability of Potential Groundwater Banking Sites in the Central Valley”. September 2001

Natural Heritage Institute. “Feasibility Study of Maximal Program of Groundwater Banking”. December 1998

Public Policy Institute, Research Brief Issue #102, “Does California have the Water to Support Population Growth”

DWR, “Fact Sheet, Sacramento River Flood Control Project Weirs and Flood Relief Structures”.

Northern Sacramento Valley Conjunctive Water Management Investigation, “Feasibility Investigation of Re-Operation of Shasta and Oroville Reservoirs in Conjunction with Sacramento Valley Groundwater System to Augment Water Supply and Environmental Flows in the Sacramento and Feather Rivers”

California Water Plan, Bulletin 160-05, April 1, 2005, “Chapter 4, Conjunctive Management and Groundwater Storage”

Saracino & Mount, LLC. “Panel Review of the Draft Bay Delta Conservation Plan: Prepared for the Nature Conservancy and American Rivers”

ACWA. 2011. “Sustainability from the Ground Up. Groundwater Management in California – A Framework”.

AGWA. 2000. “Groundwater and Surface Water in Southern California: A Guide to Conjunctive Use”.

California Natural Resources Agency. 2008. “Managing an Uncertain Future: Climate Change Adaption Strategies for California’s Water.”

DWR. 2003a. “California’s Groundwater. Bulletin 118, Update 2003”

Famiglietti, J.S., et al., “Geophysical Research Letters Vol. 38, L03403”

Faunt, C. C., editor. 2009. “Groundwater Availability of the Central Valley Aquifer, California. U.S. Geological Survey Professional Paper 1766”

Nelson, Rebecca. 2011. “Uncommon Innovation: Developments in Groundwater Management Planning in California”

STCDA, “Comments on BDCP First Amendment to the Memorandum of Agreement Regarding Collaboration on the Planning, Preliminary Design, and Environmental Compliance for the Delta Habitat Conservation and Conveyance Program in Connection with the Development of the Bay Delta Conservation Plan”

U.S. Department of the Interior, “Madera Irrigation District Water Supply Enhancement Project: Final Environmental Impact Statement”

U.S. Department of the Interior, “Record of Decision: Madera Irrigation District Water Supply Enhancement Project”

Northern Sacramento Valley Conjunctive Water Management Program, “Final Report Public Briefing”

Delta Stewardship Council, The Delta Plan.

2013-2014 Your Questions Answered

Below is a list of common questions from landowners, stakeholders, media, and interested public received on the previously proposed BDCP, between 2013-2014. These questions and answers are available for your information but are not necessarily applicable to the current proposed project.

Benefits of BDCP
Climate Adaption
Construction Impacts
Cost and Financing
Ecosystem, Habitat, and Species
Facilities, Operation, and Deliveries
Groundwater
Other
Project Commitments, Regulations, Requirements
Project Schedule
Seismic Concerns
State Water Management Portfolio
Surface Water and Storage
Water Quality

Benefits of BDCP

Expand all

How many jobs will BDCP create?

How Can a New Water Diversion Help the Delta?

Climate Adaptation

Expand all

How has climate change been incorporated into the BDCP documents?

How will BDCP's dual conveyance operations help California adapt to water supply challenges due to climate change?

How will the BDCP address the Delta's resiliency and adaptability to the effects of climate change?

How will the BDCP protect water supplies in the event of an earthquake or levee failure?

Construction Impacts

Expand all

What aesthetic and visual impacts are expected from the BDCP and how will they be mitigated?

How will BDCP construction impact the Delta's roadways?

What are the BDCP impacts to agriculture in the Delta and how will they be mitigated?

How will noise impacts associated with the BDCP be mitigated?

What are the BDCP impacts to recreation and how will they be mitigated?

What are the BDCP impacts to public services and utilities and how will they be mitigated?

How will excavated tunnel material be used?

Will the air quality impacts during construction force hundreds of residents to move?

Will access to and maintenance of the Delta levees be maintained during the construction period?

Will BDCP construction require the dewatering of all groundwater along the entire alignment for 10 years?

What is the total amount of agricultural land in the Delta that will be impacted by construction,

including disposal of dirt and material?

Will the construction activity be phased?

How long will construction take, and how will construction activities impact residents, farming, fisheries, recreation, and other economic activities? What provisions are being made for negative impacts?

Cost and Financing

Expand all

How does the BDCP cost and water yield compare to ocean desalination and recycling?

What planning efforts have been completed, how much has it cost, and who paid for it?

What do you expect the final cost of water to the contractors will be? What are the current ranges of prices south of the Delta for agricultural water, urban water, and water for oil extraction and/or fracking?

Is there evidence that irrigators in the southern San Joaquin Valley are willing/able to pay for the water they will receive? Will that change if farmers grow annual crops of lower dollar value that are resilient to annual changes in water supplies?

Ecosystem, Habitat, and Species

Expand all

How will the BDCP help fish?

Will the BDCP improve populations of Chinook salmon and steelhead?

Does the BDCP use habitat restoration measures to “offset” adverse effects of the proposed north Delta diversions on Salmon and steelhead?

What is the timetable for restoration? How will you know that the BDCP's habitat conservation plan is moving forward successfully?

How will the fish screens on the North Delta tunnel intakes differ from the ones on the South Delta pumps?

Should the South Delta pumps, which will continue to be operated 51% of the time, including during dry years, have new screens? If not, why?

What happens if voters do not approve bond measures? Could conveyance construction begin before restoration funding is secured?

How would BDCP construction affect sandhill cranes in the Delta?

Would the BDCP Benefit All 56 Species It Would Cover?

Facilities, Operation, and Deliveries

Expand all

Will the BDCP replace the Delta's current pumping system?

Are the tunnel diversions based on established criteria?

Why are the baseline estimates for exports under the EIR/EIS no action alternative different than the baseline estimates for the "No BDCP" export scenario in BDCP Chapter 9?

How will gravity move water through the tunnels without intermediate pumps?

What provisions are proposed for maintaining these tunnels over the life of the project?

What are the anticipated deliveries to State and Federal project contractors in wet, average, and dry years? How many acre-feet are expected to be pumped through the South Delta pumps during those same wet, average, and dry years?

In addition to "anticipated" water deliveries, what will be the maximum delivery possible if the tunnels are built to the maximum size (9,000 cfs capacity)?

Would BDCP require reoperation of upstream dams, especially on the Sacramento River?

Groundwater

Expand all

Will the BDCP impact private wells in the Delta?

Will the BDCP impact groundwater levels in the Delta?

Will water pumped from the Delta be used for fracking in the Central Valley?

Other

Expand all

How many comments have been received?

Will the BDCP's significant and unavoidable impacts be mitigated?

What happens with my comments?

Why isn't correspondence posted to the BDCP website during the public review period?

How many environmental impacts does the BDCP have?

Why are the draft documents so massive?

Project Commitments, Regulations, Requirements

Expand all

Why doesn't the BDCP include provisions for water users to reduce their reliance on the Delta? Isn't that a requirement of the 2009 Delta Reform Act?

What is the purpose of the Draft Implementing Agreement?

What does the BDCP Draft Implementing Agreement do?

Can the public comment on the Draft Implementing Agreement?

What has the BDCP done to reach out to environmental justice communities?

What are the legal requirements regarding outreach to environmental justice communities?

In terms of the Draft BDCP and Draft EIR/EIS, what is the difference between mitigation and restoration?

If species are not recovering, at what point will the fisheries agencies suspend the "take" permits, and what is the plan for export water deliveries if that occurs?

Where does authority lie to stop a particular BDCP action in response to an emergency or changed circumstance?

Is a Biological Opinion required prior to the release of the Draft BDCP?

How has the BDCP ensured transparency in its planning?

Project Schedule

Expand all

What happens with public comments received after the July 29 deadline, and what follows the

end of the comment period?

Will the public review and comment period for the Draft BDCP and EIR/EIS be extended?

Seismic Concerns

Expand all

How many seismic faults will the proposed tunnels cross? At what depth?

Because there's uncertainty about seismic risk, should we do nothing to address it?

Is the Delta an active seismic region?

State Water Management Portfolio

Expand all

Would conservation and improved water use efficiency of existing water supplies replace the need for the BDCP?

Will Delta levees continue to be maintained with or without BDCP?

What is the California Water Action Plan, and how does the BDCP fit into it?

Why can’t the BDCP be replaced by desalination?

Surface Water and Storage

Expand all

Why is additional storage not considered as a component of BDCP?

While water storage is a critically important tool for managing California's water resources, developing new water supplies and including new storage is not part of the BDCP purpose and need. Additional water storage was eliminated from consideration in the BDCP EIR/EIS through the alternatives development and screening process.

The BDCP is a stand-alone project that demonstrates independent utility just as future storage projects would demonstrate. However, without improvements to the existing conveyance system, the ability to capture and deliver additional water supplies from north of the Delta to two-thirds of the state will continue to be constrained by pumping restrictions in the south Delta. Public water agencies are investing in the BDCP to secure existing water supply against future risk, including climate change and earthquakes.

The need for storage is being addressed outside of the BDCP planning process. Expanding water storage and capacity and improving groundwater management are among the actions identified in the California Water Action Plan to address California's overall water needs.

Where will the project store the extra water that comes in wet years?

The BDCP does not propose any new south Delta storage facilities as part of project implementation. The BDCP also does not call for any more water diversions than is authorized by state and federal law, but it does propose to make water deliveries when the water is available, depending on variety of operational considerations, including time of year, Delta water levels, and needs for fish.

With existing Delta regulatory constraints, the existing SWP and Central Valley Project (CVP) storage south of the Delta is not used to full capacity every year (e.g. San Luis Reservoir). In addition, there are a number of other ways water can be stored south of delta for use. For example, local projects already exist for storage through groundwater banking programs.

The California Natural Resources Agency, California Environmental Protection Agency and the California Department of Food and Agriculture recently released a draft Water Action Plan to identify actions to implement water policy in California. Aimed at providing the foundation for sustainable water resource management, specific actions include expanding water storage capacity.

Why is no nonstructural alternative for achieving habitat and species restoration being considered?

Will the BDCP affect upstream reservoirs or cause "dead pool" conditions?

Can the BDCP Drain the Sacramento River?

Would BDCP Divert More Water from the Delta?

Water Quality

Expand all

Will BDCP cause a higher concentration of bromide (which contributes to salinity) in the Delta?

Will the BDCP increase salinity in the Delta?

What is the timetable for the State Water Resources Control board to place and enforce limits on water that can be exported from the Delta so that outflows and water quality will be preserved?

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CALIFORNIA
WATER FIX
RELIABLE. CLEAN. WATER.



INTAKE DESIGN REVIEW

Design Construction Enterprise

AGENDA

- Introductions
- Meeting Purpose
- Overview of intake design
- Review of questions from last meeting
- Operations and Maintenance
- FFTT Studies
- Schedule

INTAKES – DRAWING REVIEW



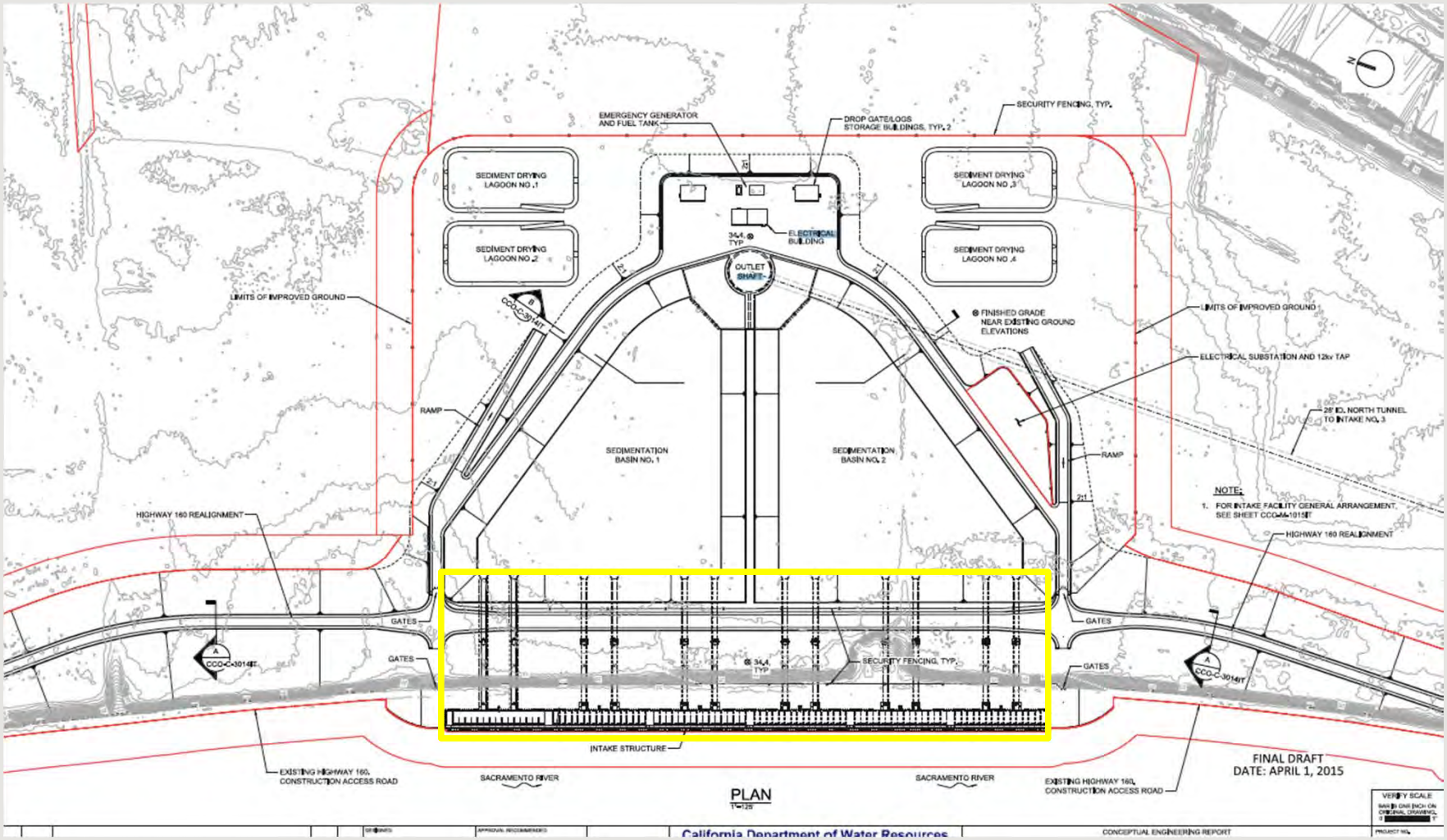
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PRELIMINARY FISH SCREEN DESIGN CRITERIA

Criterion	Description
General	
Intake Technology	On-bank intake
Number of Intakes	3
Maximum Single Intake Structure Capacity	3,000 cfs
Maximum System Flow Capacity	9,000 cfs
Hydraulic Intake Criteria	
Screen Approach Velocity	.20 fps
Screen Sweeping Velocity	≥0.20 fps

MWD004395

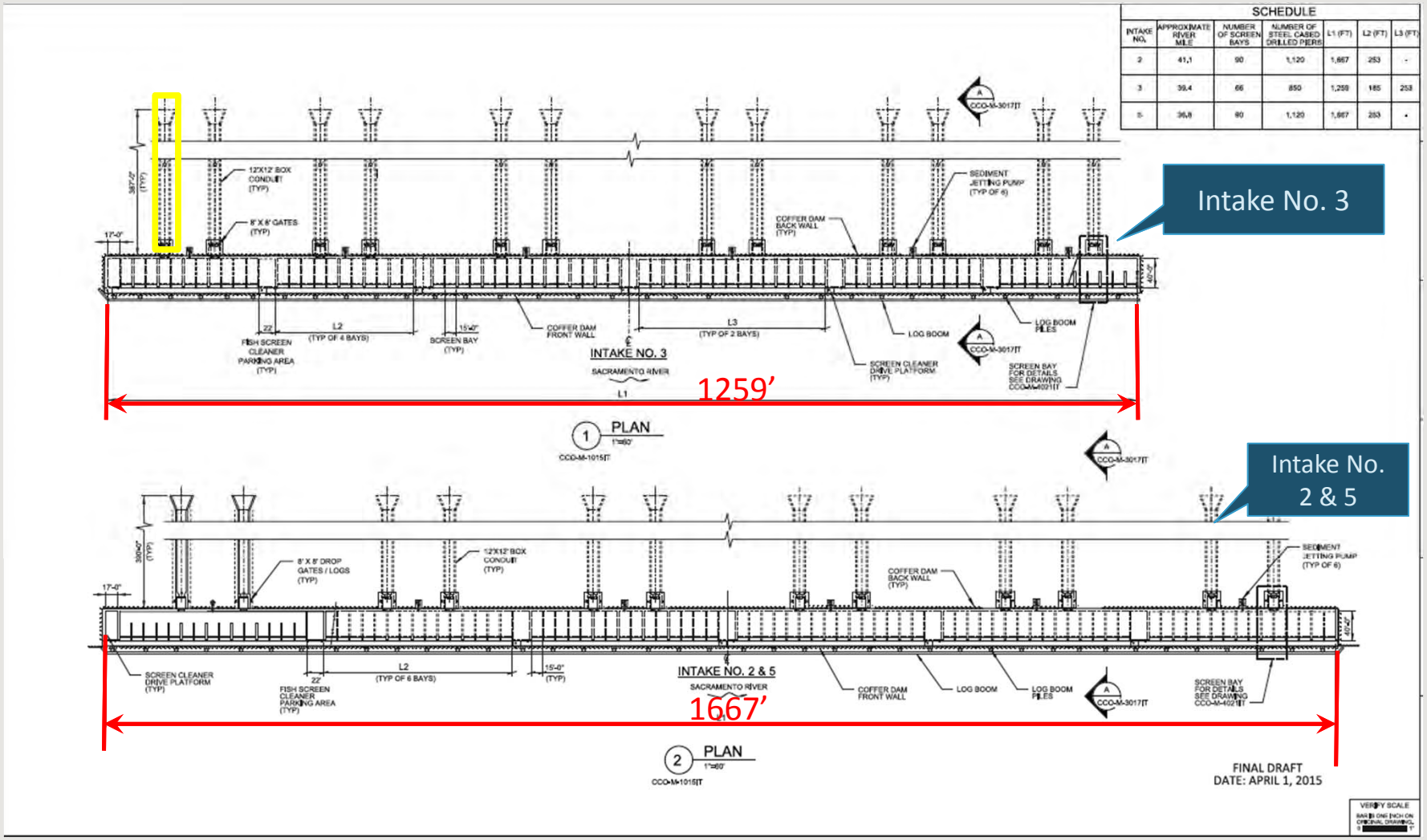
INTAKES – DRAWING REVIEW



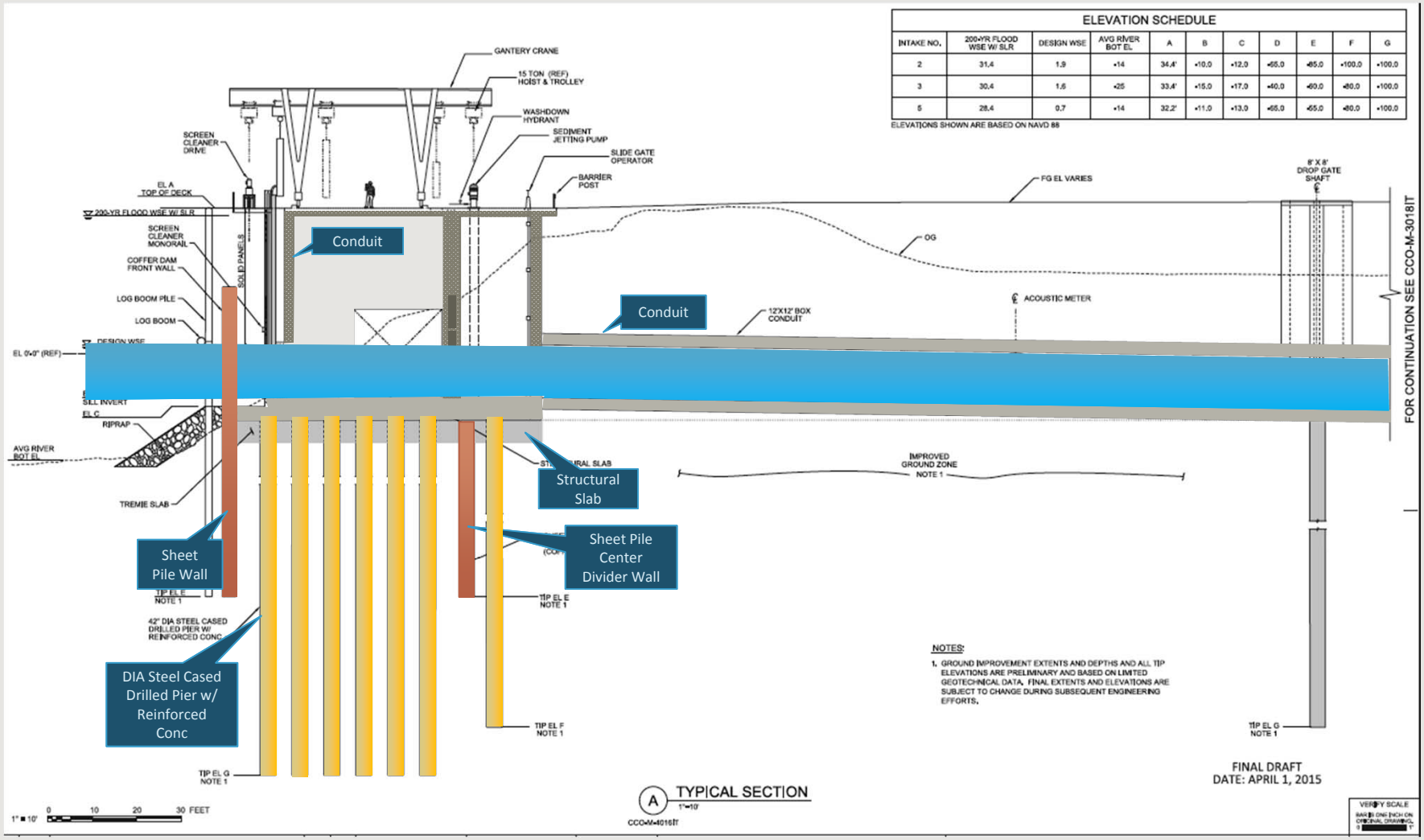
No. 2 site plan

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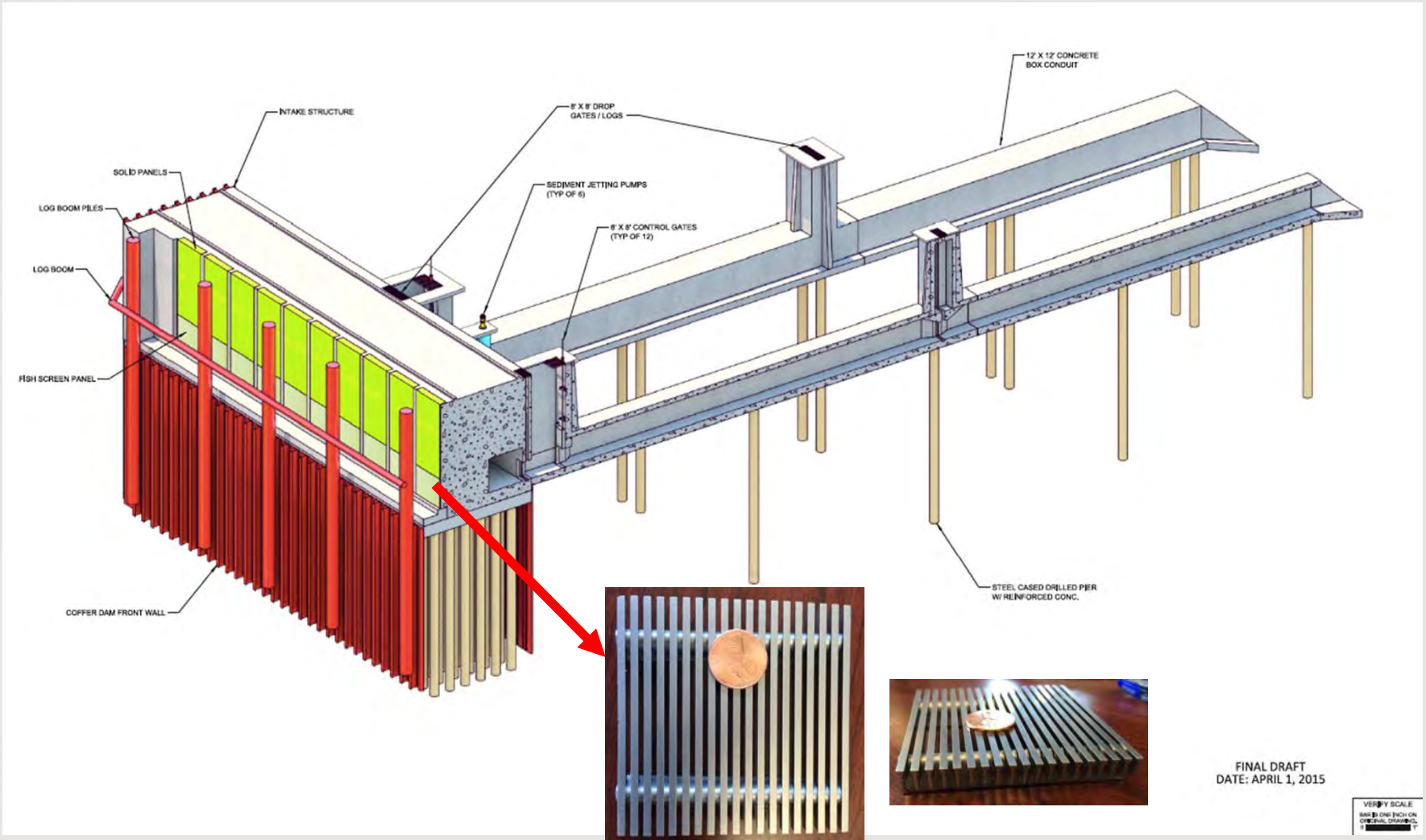
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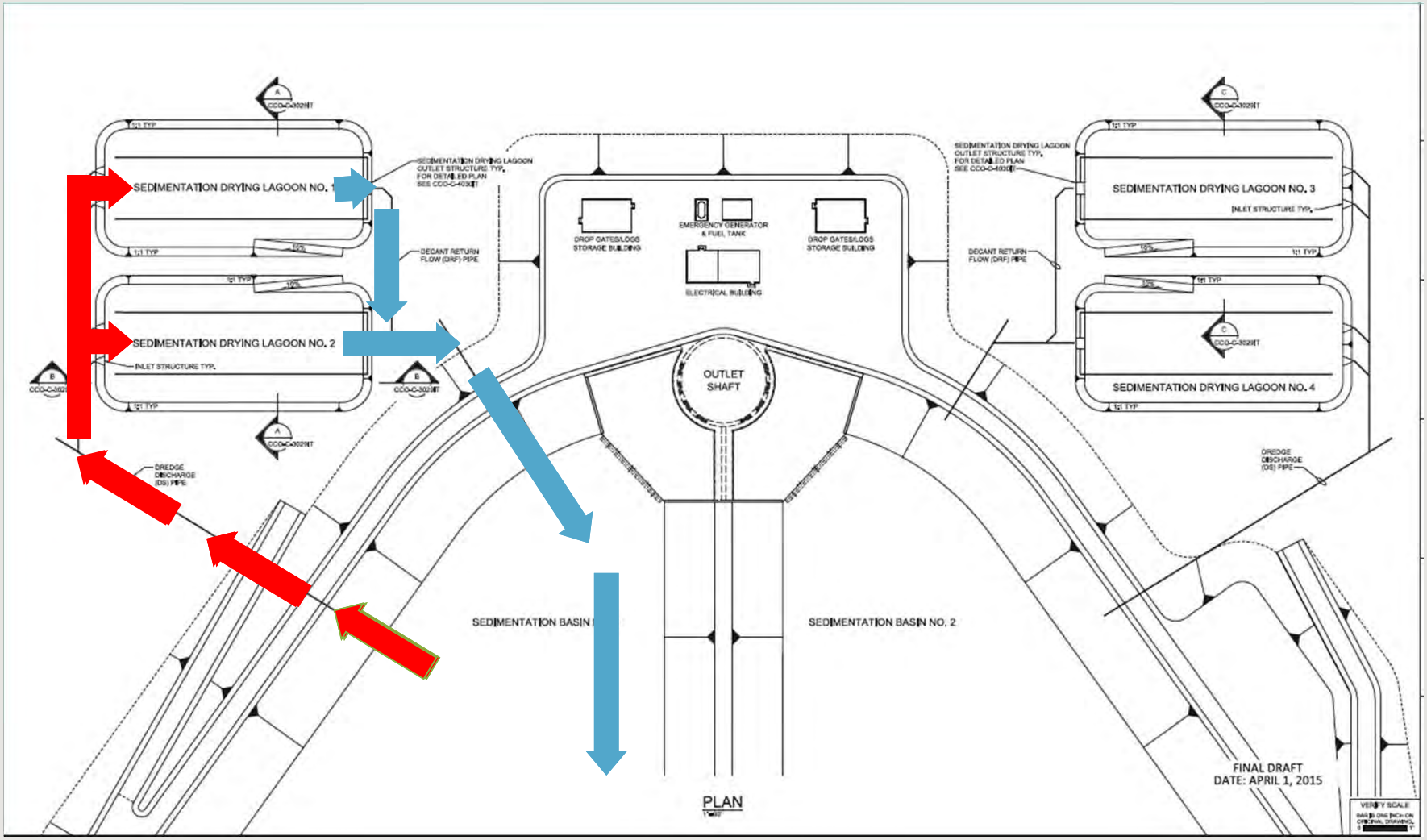
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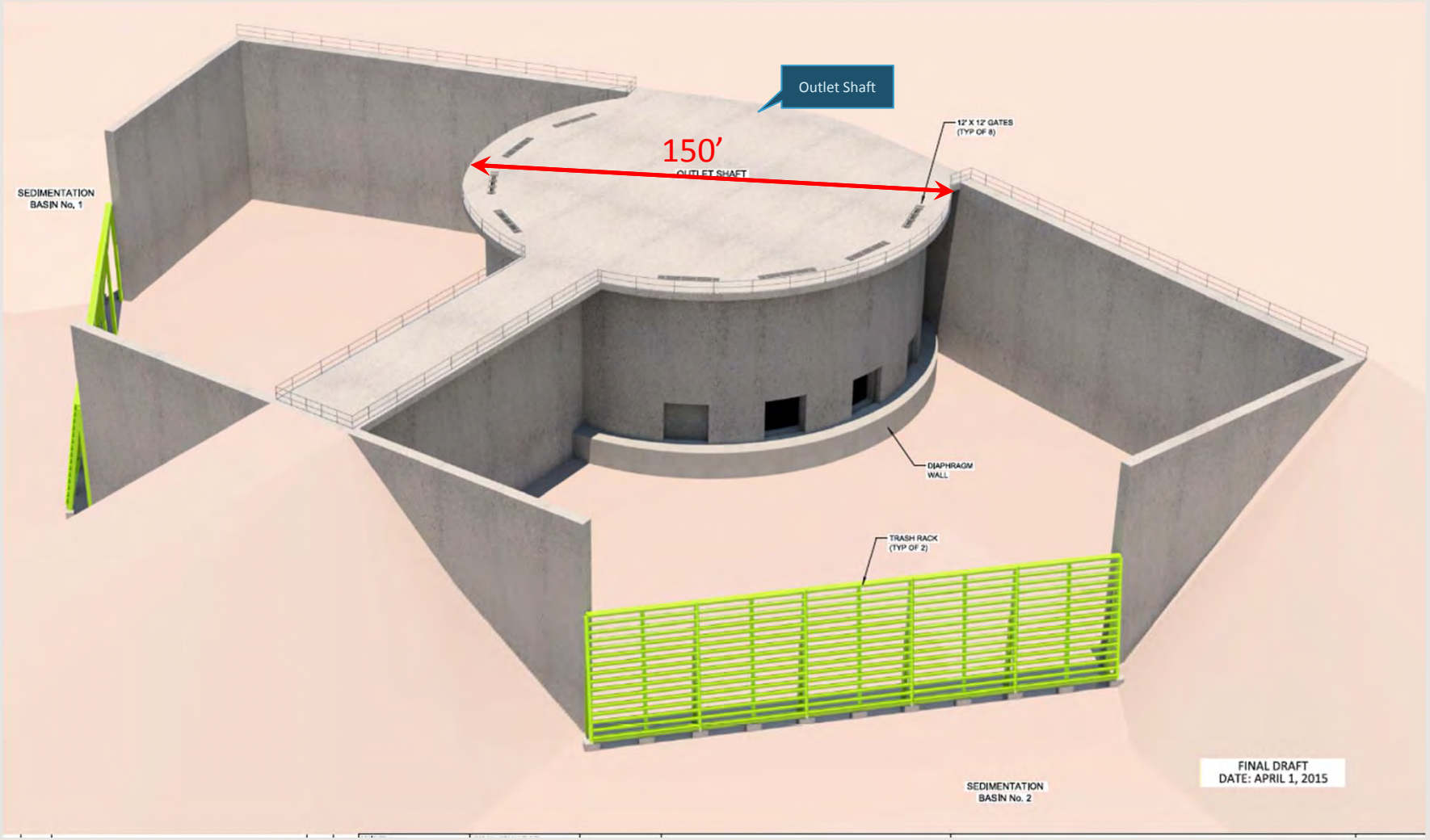


SEDIMENTATION BASINS – DRAWING REVIEW



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SHAFTS – DRAWING REVIEW



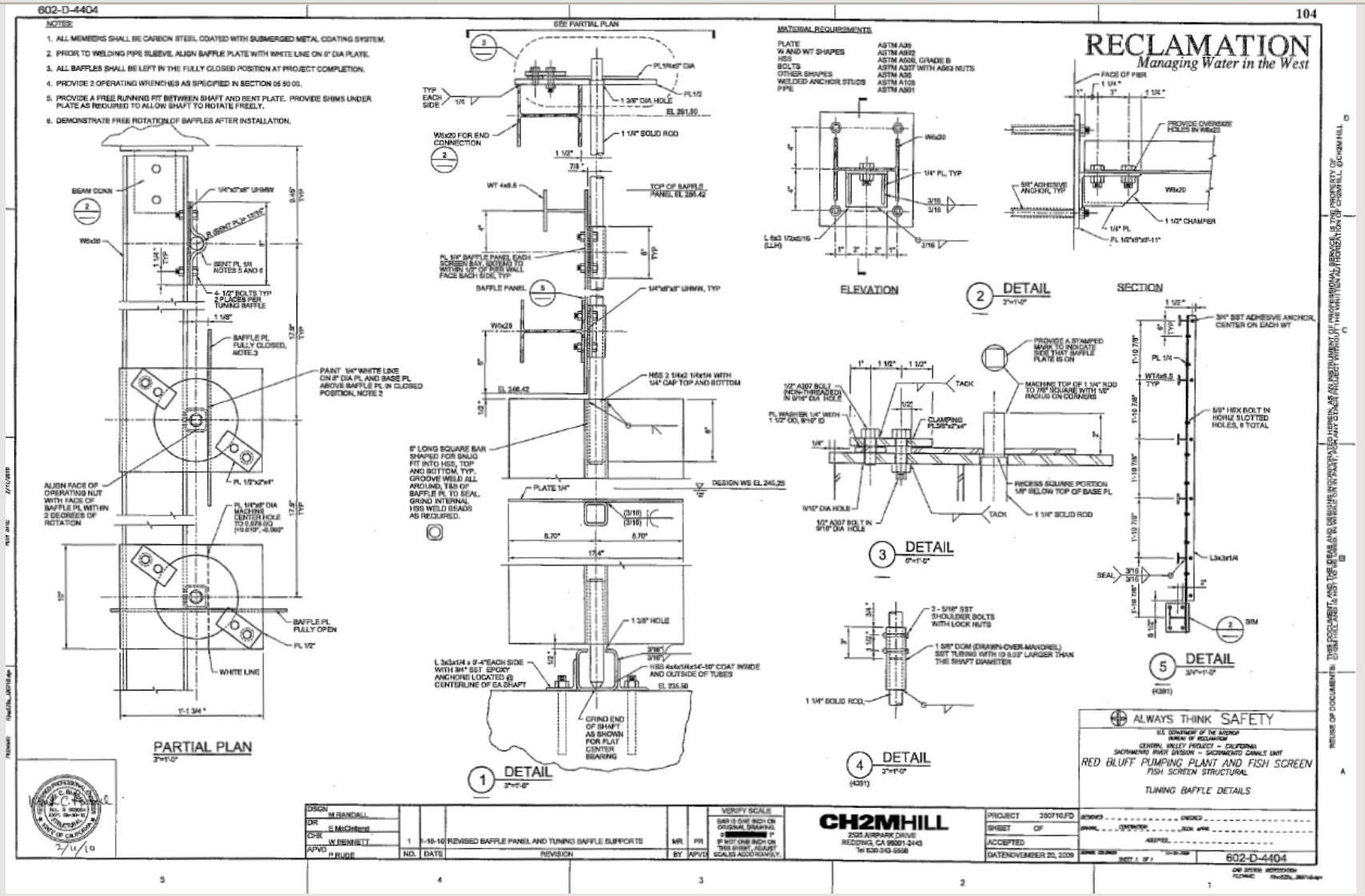
INTAKES – DRAWING REVIEW



QUESTION FROM LAST MEETING

- **What size are the baffles on the fish screens?**
- **What is the size/design of the refugia?**
- **How will the sweeping velocity past the screens be measured?**
- **How often will the sediment basins (at the intakes) be cleaned out?**
- **Where will the sediment be disposed?**
- **What will be frequency be for dredging the sediment in front of the screens?**
- **What's the depth of the fish screens?**
- **Do you have more detailed design for the barge landings?**
- What is the design for the HORB?
- What are the assumptions for the HORB borrow and spoils sites, staging areas, access roads?

INTAKE STUDIES WORK PLAN

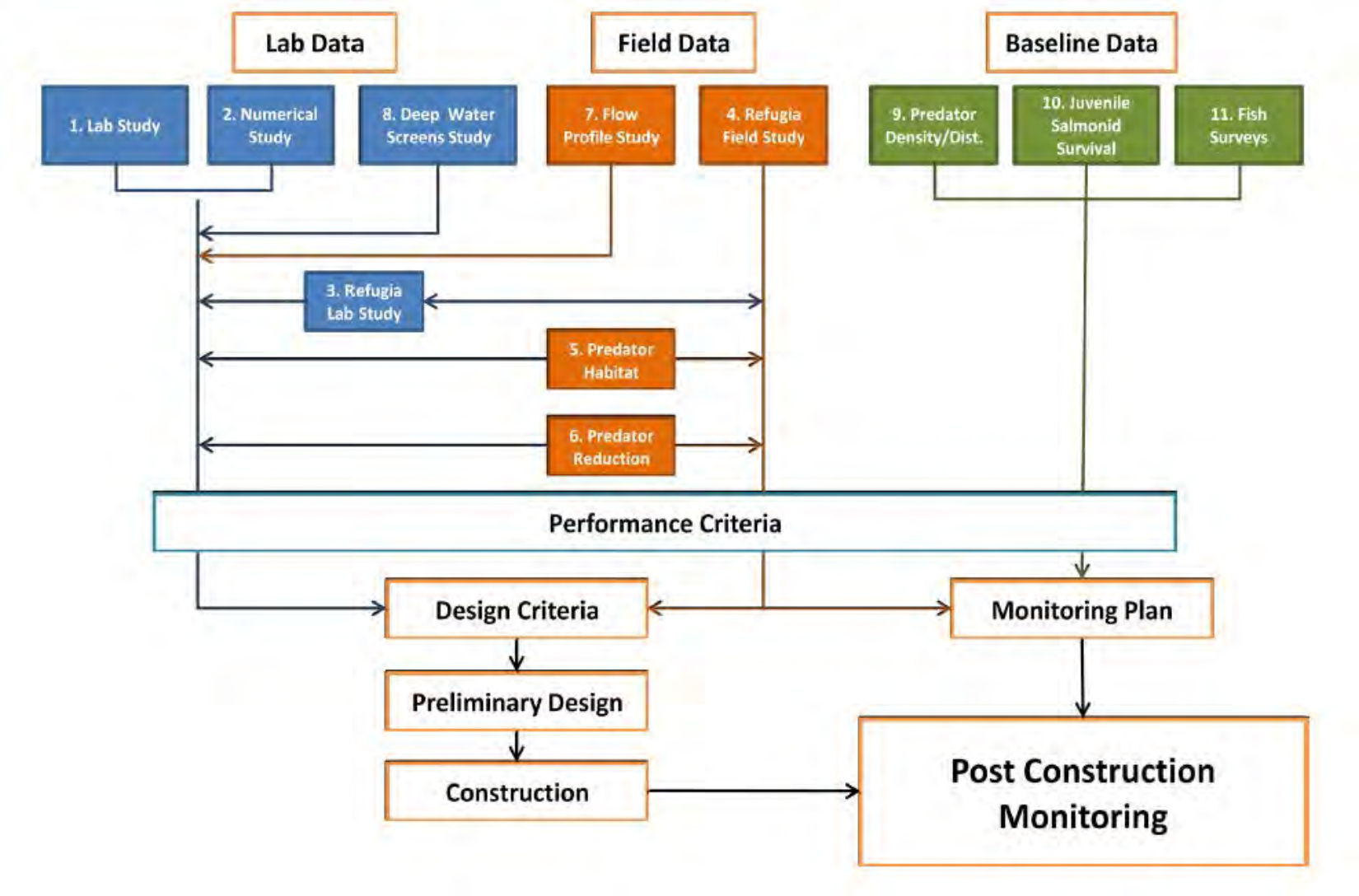


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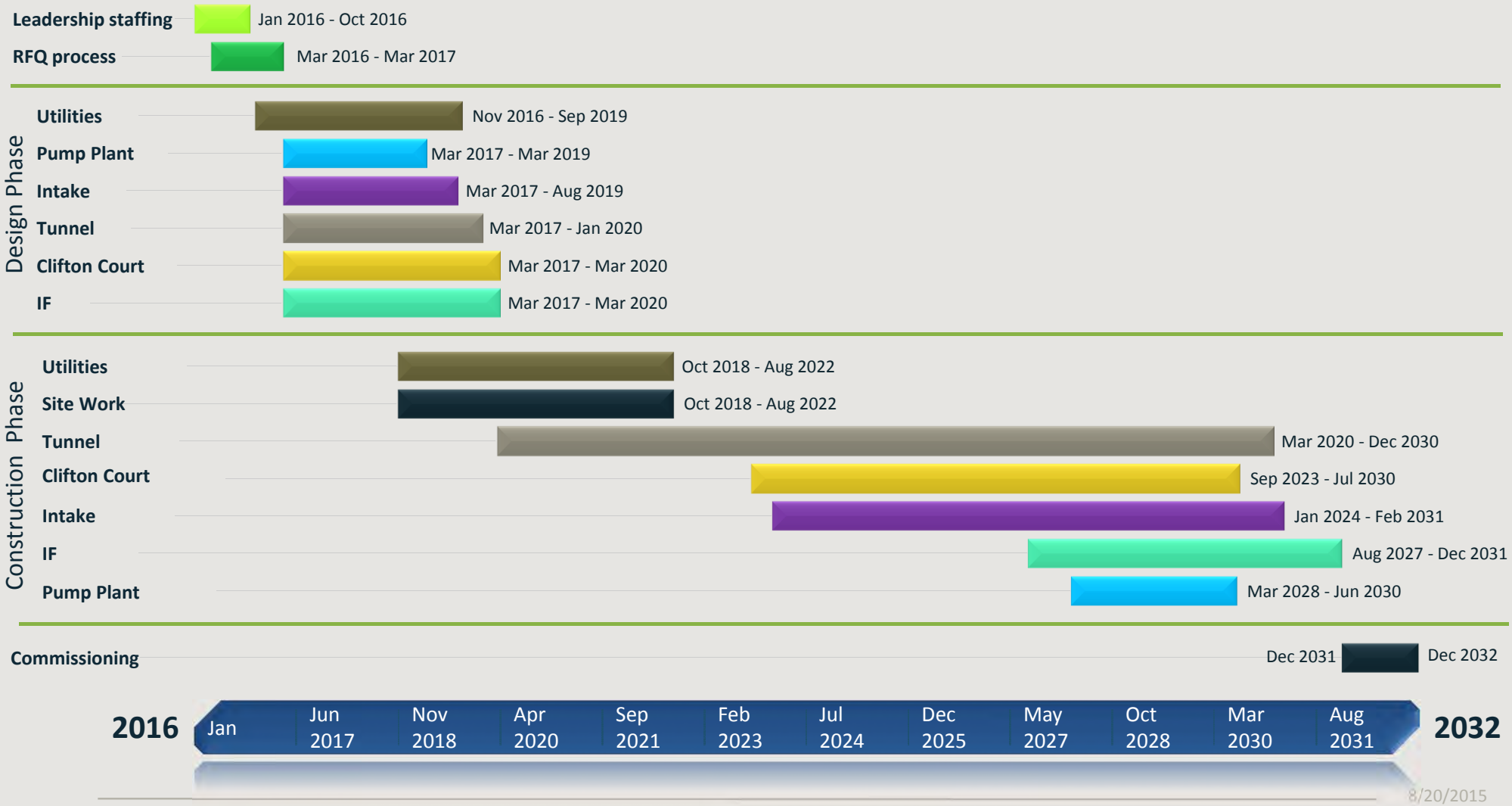
INTAKE STUDIES WORK PLAN

1. Site Locations Lab Study
2. Site Locations Numerical Study .
3. Refugia Lab Study
4. Refugia Field Study
5. Predator Habitat Locations
6. Predator Reduction Methods
7. Flow Profiling Field Study
8. Deep Water Screens Study
9. Baseline Predator Density and Distribution
10. Reach-Specific Baseline Juvenile Salmonid Survival Rates
11. Baseline Fish Surveys

INTAKE STUDIES WORK PLAN

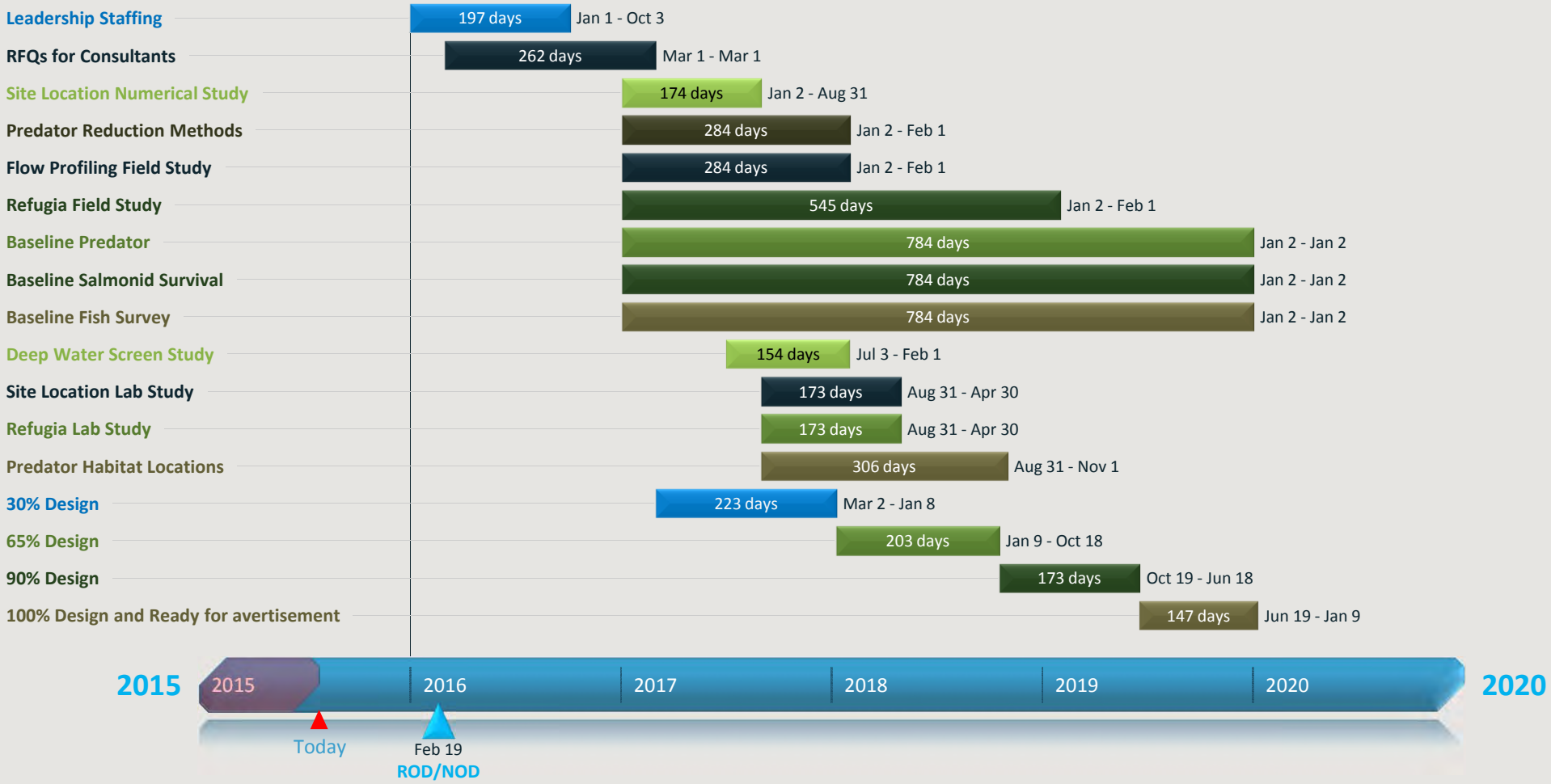


DCE PROGRAM SCHEDULE

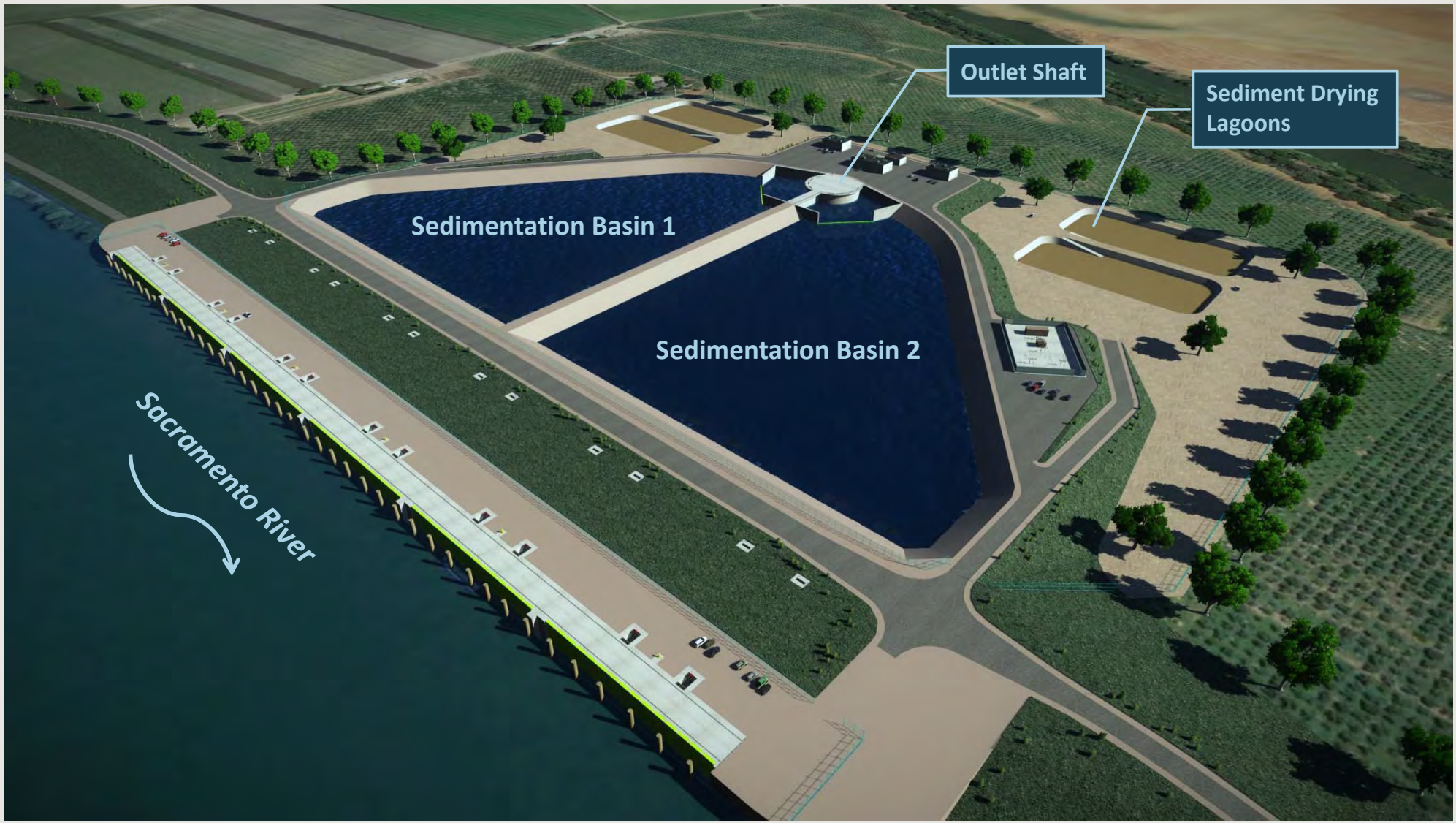


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INTAKE DESIGN SCHEDULE



RIVER INTAKES – OPTIMIZED



INTAKE ANIMATION



Note to Readers:

This report, required by Water Code section 85086(c) (2009 Delta Reform Act) in 2010, suggests the flows that would be needed in the Delta ecosystem if fishery protection was the sole purpose for which its waters were put to beneficial use. In keeping with the narrow focus of the legislation, this report only presents a technical assessment of flow and operational requirements to provide fishery protection under existing conditions.

We know however, that there are many other important beneficial uses that these waters support such as municipal and agricultural water supply and recreational uses. The State Water Board is required by law to establish flow and other objectives that ensure the reasonable protection of beneficial uses. In order for any flow objective to be reasonable, the State Water Board must consider and balance all competing uses of water in its decision-making. More broadly, the State Water Board will factor in relevant water quality, water rights and habitat needs as it considers potential changes to its Bay-Delta objectives. Any attempts to portray the recommendations contained in this report as an indicator of future State Water Board decision-making ignores this critical, multi-dimensional balancing requirement and misrepresents current efforts to analyze the water supply, economic, and hydropower effects of a broad range of alternatives. This report represents only one of many factors that will need to be balanced by the State Water Board as it updates the Bay-Delta Water Quality Control Plan. For more current information on the State Water Board's Bay-Delta Plan update efforts, please visit http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/.

State Water Resources Control Board
California Environmental Protection Agency

Development of Flow Criteria for the Sacramento-San Joaquin Delta Ecosystem

Prepared Pursuant to the Sacramento-San Joaquin Delta Reform Act of 2009



August 3, 2010

State of California
Governor Arnold Schwarzenegger

California Environmental Protection Agency
Linda Adams, Secretary, Cal EPA

State Water Board
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Frances Spivy-Weber, Vice-Chair
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State Water Resources Control Board
California Environmental Protection Agency

Development of Flow Criteria for the Sacramento-San Joaquin Delta Ecosystem

Prepared Pursuant to the Sacramento-San Joaquin Delta Reform Act of 2009

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Acknowledgements

The State Water Resources Control Board (State Water Board or Board) acknowledges the following for their contributions and participation in the Board's Delta Flow Criteria proceding:

- The professors, researchers, and staff from various resource agencies that comprise the Delta Environmental Flows Group (DEFG) for providing valuable information and insights that informed the Delta flow criteria informational proceeding, and whose work was cited liberally throughout this report
- The UC Davis Delta Solutions Group, a subset of the DEFG for providing additional insights in their reports on habitat variability, flow presecriptions, and ecosystem investments
- The California Department of Fish and Game for working collaboratively with the State Water Board on development of species life history requirements and for reviewing portions of the draft report
- The United States Fish and Wildflie Service and National Marine Fisheries Service for reviewing portions of the draft report
- All the participants of the proceeding for providing information and serving on panels to answer questions during the proceeding

The State Water Board, however, is responsible for any errors and for all interpretations of the information in this report.

STATE WATER RESOURCES CONTROL BOARD
RESOLUTION NO. 2010-0039

DETERMINING DELTA FLOW CRITERIA PURSUANT TO THE DELTA REFORM ACT

WHEREAS:

1. Water Code section 85086, contained in the Sacramento-San Joaquin Delta Reform Act of 2009 (Stats. 2009 (7th Ex. Sess.) ch. 5) (commencing with Wat. Code, § 85000), requires the State Water Resources Control Board (State Water Board) to develop, within nine months of enactment of the statute, new flow criteria for the Sacramento-San Joaquin Delta (Delta) ecosystem that are necessary to protect public trust resources. The purpose of the flow criteria is to inform planning decisions for the Delta Plan and the Bay Delta Conservation Plan. The statute specifies that the flow criteria shall not predetermine any issue that may arise in the State Water Board's subsequent consideration of a permit.

2. In accordance with Water Code section 85086, subdivision (c)(1), the State Water Board conducted a public process in the form of an informational proceeding to collect information used to develop the flow criteria. The State Water Board conducted the informational proceeding on March 22-24, 2010, and considered the information submitted in connection with that proceeding in developing the flow criteria.

3. The State Water Board has prepared a report determining flow criteria for the Delta ecosystem necessary to protect public trust resources. In developing the flow criteria, the State Water Board reviewed existing water quality objectives and used the best available scientific information. The flow criteria include the volume, timing, and quality of flow necessary under different hydrologic conditions.

THEREFORE BE IT RESOLVED THAT:

1. In accordance with the Delta Reform Act, the State Water Board approves the report determining new flow criteria for the Delta ecosystem that are necessary to protect public trust resources.

2. The Executive Director is directed to submit the Delta flow criteria report to the Delta Stewardship Council for its information within 30 days of the adoption of this resolution.

CERTIFICATION

The undersigned Clerk to the Board does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the State Water Board held on August 3, 2010.

AYE:	Chairman Charles R. Hoppin Vice Chair Frances Spivy-Weber Board Member Arthur G. Baggett, Jr. Board Member Tam M. Doduc Board Member Walter G. Pettit
NAY:	None
ABSENT:	None
ABSTAIN:	None

Jeanine Townsend
Clerk to the Board

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Acronyms and Abbreviations

AFRP	Anadromous Fish Restoration Program
AR	American Rivers
Bay-Delta	San Francisco Bay/Sacramento-San Joaquin Delta Estuary including Suisun Marsh
Bay-Delta Plan	Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary
BDCP	Bay Delta Conservation Program
CCWD	Contra Costa Water District
Central Valley Regional Board	Central Valley Regional Water Quality Control Board
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
cfs	cubic feet per second
Council	Delta Stewardship Council
CSPA	California Sportfishing Protection Alliance
CVP	Central Valley Project
CWIN	California Water Impact Network
DEFG	Delta Environmental Flows Group
Delta	Confluence of the Sacramento River and San Joaquin River (as defined in Water Code section 12220)
Delta Plan	Delta Stewardship Council comprehensive, long-term management plan for the Delta
Delta Reform Act	Sacramento-San Joaquin Delta Reform Act of 2009
DFG	California Department of Fish and Game
DO	dissolved oxygen
DOI	United States Department of the Interior
DSM2	Delta Simulation Model
DWR	California Department of Water Resources
DWSC	Stockton Deep Water Ship Channel
E/I	Export/Inflow ratio
EC	Electrical Conductivity
EDF	Environmental Defense Fund
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
FMWG	Fisheries Management Work Group
FMWT	Fall mid-water trawl
IEP	Interagency Ecological Program
LSZ	Low Salinity Zone
MAF	million acre-feet
mg/L	milligrams per liter
mmhos/cm	millimhos per centimeter
NAS	National Academy of Sciences
NCCPA	State Natural Community Conservation Planning Act
NDOI	Net Delta Outflow Index
NEPA	National Environmental Policy Act
NHI	Natural Heritage Institute

NMFS	National Marine Fisheries Service
NRDC	Natural Resources Defense Council
OCAP	Long-Term Operations Criteria and Plan for Coordination of the Central Valley Project and the State Water Project
OMR	Old and Middle River
Opinion	Biological Opinion
PCFFA	Pacific Coast Federation of Fishermen's Associations
POD	Pelagic Organism Decline
ppt	parts per thousand
psu	practical salinity unit
PTM	Particle Tracking Model
RMP	Regional Monitoring Program
RPA	Reasonable and Prudent Alternatives
San Francisco Regional Board	San Francisco Bay Regional Water Quality Control Board
SB 1	Senate Bill No. 1 of the 2009-2010 Seventh Extraordinary Session (Stats. 2009 (7th Ex. Sess.) ch. 5, § 39)
SFWC	State and Federal Water Contractors
SJRA	San Joaquin River Agreement
SJRGA	San Joaquin River Group Authority
SJRRP	San Joaquin River Restoration Program
SRWTP	Sacramento Regional Wastewater Treatment Plant
State Water Board	State Water Resources Control Board
SWG	Smelt Working Group
SWP	State Water Project
TBI	The Bay Institute
TNC	The Nature Conservancy
USACE	U.S. Army Corps of Engineers
USBR	United States Bureau of Reclamation
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VAMP	Vernalis Adaptive Management Plan
WOMT	Water Operations Management Team

1. Executive Summary

The Sacramento-San Joaquin Delta (Delta) is a critically important natural resource for California and the nation. It is both the hub of California's water supply system and the most valuable estuary and wetlands on the western coast of the Americas. The Delta is in ecological crisis, resulting in high levels of conflict that affect the sustainability of existing water policy in California. Several species of fish have been listed as protected species under the California Endangered Species Act (CESA) and under the federal Endangered Species Act (ESA). These two laws and other regulatory constraints have restricted water diversions from the Delta in an effort to prevent further harm to the protected species.

In November 2009, California enacted a comprehensive package of four policy bills and a bond measure intended to meet California's growing water challenges by adopting a policy of sustainable water supply management to ensure a reliable water supply for the State and to restore the Delta and other ecologically sensitive areas. One of these bills, Senate Bill No. 1 (SB 1) (Stats. 2009 (7th Ex. Sess.) ch 5, § 39) contains the Sacramento-San Joaquin Delta Reform Act of 2009 (Delta Reform Act), Water Code section 85000 et seq. The Delta Reform Act establishes a Delta Stewardship Council (Council), tasked with developing a comprehensive, long-term management plan for the Delta, known as the Delta Plan, and providing direction to multiple state and local agencies that take actions related to the Delta. The comprehensive bill package also sets water conservation policy, requires increased groundwater monitoring, and provides for increased enforcement against illegal water diversions.

The Delta Reform Act requires the State Water Board to use a public process to develop new flow criteria for the Delta ecosystem. During this process, participants cautioned the the State Water Board on the limitations of any flow criteria (Fleenor *et al*., 2010):

> "How much water do fish need?" has been a common refrain in Delta water management for many years it is highly unlikely that any fixed or predetermined prescription will be a "silver bullet". The performance of native and desirable fish populations in the Delta requires much more than fresh water flows. Fish need enough water of appropriate quality over the temporal and spatial extent of habitats to which they adapted their life history strategies. Typically, this requires habitat having a particular range of physical characteristics, appropriate variability, adequate food supply and a diminished set of invasive species. While folks ask "How much water do fish need?" they might well also ask, "How much habitat of different types and locations, suitable water quality, improved food supply and fewer invasive species that is maintained by better governance institutions, competent implementation and directed research do fish need?" The answers to these questions are interdependent. We cannot know all of this now, perhaps ever, but we do know things that should help us move in a better direction, especially the urgency for being proactive. We do know that current policies have been disastrous for desirable fish. It took over a century to change the Delta's ecosystem to a less desirable state; it will take many decades to put it back together again with a different physical, biological, economic, and institutional environment."

The State Water Board concurs with this cautionary note. The State Water Board further cautions that flow and physical habitat interact in many ways, but they are not interchangeable.

The best available science suggests that current flows are insufficient to protect public trust resources.

1.1 Legislative Directive and State Water Board Approach

Legislative Directive

Water Code section 85086 (See Appendix B), contained in the Delta Reform Act, was enacted as part of the comprehensive package of water legislation adopted in November 2009. Water Code section 85086 requires the State Water Resources Control Board (State Water Board) to use the best available scientific information gathered as part of a public process conducted as an informational proceeding to develop new flow criteria for the Delta ecosystem to protect public trust resources. The purpose of the flow criteria is to inform planning decisions for the Delta Plan and the BDCP. The Legislature intended to establish an accelerated process to determine the instream flow needs of the Delta in order to facilitate the planning decisions required to meet the objectives of the Delta Plan. Accordingly, Water Code section 85086 requires the State Water Board to develop the flow criteria within nine months of enactment of the statute and to submit its flow criteria determinations to the Council within 30 days of their development.

State Water Board Approach

In determining the extent of protection to be afforded public trust resources through the development of the flow criteria, the State Water Board considered the broad goals of the planning efforts the criteria are intended to inform, including restoring and promoting viable, self-sustaining populations of aquatic species. Given the accelerated time frame in which to develop the criteria, the State Water Board's approach to developing criteria was limited to review of instream needs in the Delta ecosystem, specifically fish species and Delta outflows, while also receiving information on hydrodynamics and major tributary inflows. The State Water Board's flow criteria determinations are accordingly limited to protection of aquatic resources in the Delta.

Limitations of State Water Board Approach

When setting flow objectives with regulatory effect, the State Water Board reviews and considers all the effects of the flow objectives through a broad inquiry into all public trust and public interest concerns. For example, the State Water Board would consider other public trust resources potentially affected by Delta outflow requirements and impose measures for the protection of those resources, such as requiring sufficient water for cold water pool in reservoirs to maintain temperatures in Delta tributaries. The State Water Board would also consider a broad range of public interest matters, including economics, power production, human health and welfare requirements, and the effects of flow measures on non-aquatic resources (such as habitat for terrestrial species). The limited process adopted for this proceeding does not include this comprehensive review.

The State Water Board's Public Trust Responsibilities in this Proceeding

Under the public trust doctrine, the State Water Board must take the public trust into account in the planning and allocation of water resources, and to protect public trust uses whenever feasible. (*National Audubon Society v. Superior Court* (1983) 33 Cal.3d 419, 446.) Public trust values include navigation, commerce, fisheries, recreation, scenic, and ecological values. "[I]n determining whether it is 'feasible' to protect public trust values like fish and wildlife in a particular instance, the [State Water] Board must determine whether protection of those values, or what level of protection, is 'consistent with the public interest.'" (*State Water Resources*

Control Bd. Cases (2006) 136 Cal.App.4th 674, 778.) The State Water Board does not make any determination regarding the feasibility of the public trust criteria and consistency with the public interest in this report.

In this forum, the State Water Board has not considered the allocation of water resources, the application of the public trust to a particular water diversion or use, water supply impacts, or any balancing between potentially competing public trust resources (such as potential adverse effects of increased Delta outflow on the maintenance of coldwater resources for salmonids in upstream areas). Any such application of the State Water Board's public trust responsibilities, including any balancing of public trust values and water rights, would be conducted through an adjudicative or regulatory proceeding. Instead, the State Water Board's focus here is solely on identifying public trust resources in the Delta ecosystem and determining the flow criteria, as directed by Water Code section 85086.

Future Use of This Report

None of the determinations in this report have regulatory or adjudicatory effect. Any process with regulatory or adjudicative effect must take place through the State Water Board's water quality control planning, water rights processes, or public trust proceedings in conformance with applicable law. In the State Water Board's development of Delta flow objectives with regulatory effect, it must ensure the reasonable protection of beneficial uses, which may entail balancing of competing beneficial uses of water, including municipal and industrial uses, agricultural uses, and other environmental uses. The State Water Board's evaluation will include an analysis of the effect of any changed flow objectives on the environment in the watersheds in which Delta flows originate, the Delta, and the areas in which Delta water is used. It will also include an analysis of the economic impacts that result from changed flow objectives.

Nothing in either the Delta Reform Act or in this report amends or otherwise affects the water rights of any person. In carrying out its water right responsibilities, the State Water Board may impose any conditions that in its judgment will best develop, conserve, and utilize in the public interest the water to be appropriated. In making this determination, the State Water Board considers the relative benefit to be derived from all beneficial uses of the water concerned and balances competing interests.

The State Water Board has continuing authority over water right permits and licenses it issues. In the exercise of that authority and duty, the State Water Board may, if appropriate, amend terms and conditions of water right permits and licenses to impose further limitations on the diversion and use of water by the water right holder to protect public trust uses or to meet water quality and flow objectives in Water Quality Control Plans it has adopted. The State Water Board must provide notice to the water permit or license holder and an opportunity for hearing before it may amend a water right permit or license.

If the DWR and/or the USBR in the future request the State Water Board to amend the water right permits for the State Water Project (SWP) and/or the Central Valley Project (CVP) to move the authorized points of diversion for the projects from the southern Delta to the Sacramento River, Water Code section 85086 directs the State Water Board to include in any order approving a change in the point of the diversion of the projects appropriate Delta flow criteria. At that time, the State Water Board will determine appropriate permit terms and conditions. That decision will be informed by the analysis in this report, but will also take many other factors into consideration, including any newly developed scientific information, habitat conditions at the time, and other policies of the State, including the relative benefit to be derived from all

beneficial uses of water. The flow criteria in this report are not pre-decisional in regard to any State Water Board action. (See e.g., Wat. Code, § 85086, subd. (c)(1).)

The information in this report illustrates to the State Water Board the need for an integrated approach to management of the Delta. Best available science supports that it is important to directly address the negative effects of other stressors, including habitat, water quality, and invasive species, that contribute to higher demands for water to protect public trust resources. The flow criteria highlight the continued need for the BDCP to develop an integrated set of solutions and to implement non flow measures to protect public trust resources.

1.2 Summary Determinations

This report contains the State Water Board's determinations as to the flows that protect public trust resources in the Delta, under the narrow circumstances analyzed in this report. As required, the report includes the volume, timing, and quality of flow for protection of public trust resources under different hydrologic conditions. The flow criteria represent a technical assessment only of flow and operational requirements that provide fishery protection under existing conditions. The flow criteria contained in this report do not represent flows that might be protective under other conditions. The State Water Board recognizes that changes in existing conditions may alter the need for flow. Changes in existing conditions that may affect flow needs include, but are not limited to, reduced reverse flows in Delta channels, increased tidal habitat, improved water quality, reduced competition from invasive species, changes in the point of diversion of the SWP and CVP, and climate change.

Flow Criteria and Conclusions

The numeric criteria determinations in this report must be considered in the following context:

- The flow criteria in this report do not consider any balancing of public trust resource protection with public interest needs for water.
- The State Water Board does not intend that the criteria should supersede requirements for health and safety such as the need to manage water for flood control.
- There is sufficient scientific information to support the need for increased flows to protect public trust resources; while there is uncertainty regarding specific numeric criteria, scientific certainty is not the standard for agency decision making.

The State Water Board has considered the testimony presented during the Board's informational proceeding to develop flow criteria and to support the following summary conclusions. Several of these summary conclusions rely in whole or in part on conclusions and recommendations made to the State Water Board by the Delta Environmental Flows Group (DEFG)[1] and the University of California at Davis Delta Solutions Group[2].

1. The effects of non-flow changes in the Delta ecosystem, such as nutrient composition, channelization, habitat, invasive species, and water quality, need to be addressed and integrated with flow measures.

[1] The Delta Environmental Flows Group of experts consists of William Bennett, Jon Burau, Cliff Dahm, Chris Enright, Fred Feyrer, William Fleenor, Bruce Herbold, Wim Kimmerer, Jay Lund, Peter Moyle, and Matthew Nobriga.

[2] The Delta Solutions Group consists of William Bennett, William Fleenor, Jay Lund, and Peter Moyle.

2. Recent Delta flows are insufficient to support native Delta fishes for today's habitats.[3] Flow modification is one of the immediate actions available although the links between flows and fish response are often indirect and are not fully resolved. Flow and physical habitat interact in many ways, but they are not interchangeable.

3. In order to preserve the attributes of a natural variable system to which native fish species are adapted, many of the criteria developed by the State Water Board are crafted as percentages of natural or unimpaired flows. These criteria include:

    - 75% of unimpaired Delta outflow from January through June;
    - 75% of unimpaired Sacramento River inflow from November through June; and
    - 60% of unimpaired San Joaquin River inflow from February through June.

    It is not the State Water Board's intent that these criteria be interpreted as precise flow requirements for fish under current conditions, but rather they reflect the general timing and magnitude of flows under the narrow circumstances analyzed in this report. In comparison, historic flows over the last 18 to 22 years have been:

    - approximately 30% in drier years to almost 100% of unimpaired flows in wetter years for Delta outflows;
    - about 50% on average from April through June for Sacramento River inflows; and
    - approximately 20% in drier years to almost 50% in wetter years for San Joaquin River inflows.

4. Other criteria include: increased fall Delta outflow in wet and above normal years; fall pulse flows on the Sacramento and San Joaquin Rivers; and flow criteria in the Delta to help protect fish from mortality in the central and southern Delta resulting from operations of the State and federal water export facilities.

5. The report also includes determinations regarding variability and the natural hydrograph, floodplain activation and other habitat improvements, water quality and contaminants, cold water pool management, and adaptive management:
    - Criteria should reflect the frequency, duration, timing, and rate of change of flows, and not just volumes or magnitudes. Accordingly, whenever possible, the criteria specified above are expressed as a percentage of the unimpaired hydrograph.

[3] This statement should not be construed as a critique of the basis for existing regulatory requirements included in the 2006 Bay-Delta Plan and biological opinions. Those requirements were developed pursuant to specific statutory requirements and considerations that differ from this proceeding. Particularly when developing water quality objectives, the State Water Board must consider many different factors including what constitutes reasonable protection of the beneficial use and economic considerations. In addition, the biological opinions for the SWP and CVP Operations Criteria and Plan were developed to prevent jeopardy to specific fish species listed pursuant to the federal Endangered Species Act; in contrast, the flow criteria developed in this proceeding are intended to halt population decline and increase populations of certain species.

- Inflows should generally be provided from tributaries to the Delta watershed in proportion to their contribution to unimpaired flow unless otherwise indicated.
- Studies and demonstration projects for, and implementation of, floodplain restoration, improved connectivity and passage, and other habitat improvements should proceed to provide additional protection of public trust uses and potentially allow for the reduction of flows otherwise needed to protect public trust resources in the Delta.
- The Central Valley and San Francisco Regional Water Quality Control Boards should continue developing Total Maximum Daily Loads (TMDLs) for all listed pollutants and adopting programs to implement control actions.
- The Central Valley Regional Water Quality Control Board should require additional studies and incorporate discharge limits and other controls into permits, as appropriate, for the control of nutrients and ammonia.
- Temperature and water supply modeling and analyses should be conducted to identify conflicting requirements to achieve both flow and cold water temperature goals.
- A strong science program and a flexible management regime are critical to improving flow criteria. The State Water Board should work with the Council, the Delta Science Program, BDCP, the Interagency Ecological Program (IEP), and others to develop the framework for adaptive management that could be relied upon for the management and regulation of Delta flows.
- The numeric criteria included in this report are all criteria that are only appropriate for the current physical system and climate; as other factors change the flow needs advanced in this report will also change. As physical changes occur to the environment and our understanding of species needs improves, the long-term flow needs will also change. Actual flows should be informed by adaptive management.
- Only the underlying principles for the numeric criteria and other measures are advanced as long term criteria.

6. Past changes in the Delta may influence migratory cues for some fishes. These cues are further scrambled by a reverse salinity gradient in the south Delta. It is important to establish seaward gradients and create more slough networks with natural channel geometry. Achieving a variable more complex estuary requires establishing seasonal gradients in salinity and other water quality variables and diverse habitats throughout the estuary. These goals in turn encourage policies which establish internal Delta flows that create a tidally-mixed upstream- downstream gradient (without cross-Delta flows) in water quality. Continued through-Delta conveyance is likely to continue the need for in-Delta flow requirements and restrictions to protect fish within the Delta.

7. Restoring environmental variability in the Delta is fundamentally inconsistent with continuing to move large volumes of water through the Delta for export. The drinking and agricultural water quality requirements of through-Delta exports, and perhaps even some current in-Delta uses, are at odds with the water quality and variability needs of desirable Delta species.

8. The Delta ecosystem is likely to dramatically shift within 50 years due to large scale levee collapse. Overall, these changes are likely to promote a more variable, heterogeneous estuary. This changed environment is likely to be better for desirable estuarine species; at least it is unlikely to be worse.

9. Positive changes in the Delta ecosystem resulting from improved flow or flow patterns will benefit humans as well as fish and wildlife.

10. In order to prevent further channelization of riparian corridors and infill of wetland habitats, the Delta Stewardship Council should consider developing a plan to coordinate land use policy within the Delta between the city, county, State, and federal governments.

Ecosystems are complex; there are many factors that affect the quality of the habitat that they provide. These factors combine in ways that can amplify the effect of the factors on aquatic resources. The habitat value of the Delta ecosystem for favorable species can be improved by habitat restoration, contaminant and nutrient reduction, changes in diversions, control of invasive species, and island flooding. Each of these non-flow factors has the potential to interact with flow to affect available aquatic habitat in Delta channels.

The State Water Board supports the most efficient use of water that can reasonably be made. The flow improvements that the State Water Board identifies in this report as being necessary to protect public trust resources illustrate the importance of addressing the negative effects of these other stressors that contribute to higher than necessary demands for water to provide resource protection. Future habitat improvements or changes in nutrients and contaminants, for example, may change the response of fishes to flow. Addressing other stressors directly will be necessary to assure protection of public trust resources and could change the demands for water to provide resource protection in the future. Uncertainty regarding the effects of habitat improvement and other stressors on flow demands for resource protection highlights the need for continued study and adaptive management to respond to changing conditions.

The flow criteria identified in this report highlight the need for the BDCP to develop an integrated set of solutions, to address ecosystem flow needs, including flow and non-flow measures. Although flow modification is an action that can be implemented in a relatively short time in order to improve the survival of desirable species and protect public trust resources, public trust resource protection cannot be achieved solely through flows – habitat restoration also is needed. One cannot substitute for the other; both flow improvements and habitat restoration are essential to protecting public trust resources.

1.3 Background and Next Steps

Informational Proceeding

The State Water Board held an informational proceeding on March 22, 23, and 24, 2010, to receive scientific information from technical experts on the Delta outflows needed to protect public trust resources. The State Water Board also received information at the proceeding on flow criteria for inflow to the Delta from the Sacramento and San Joaquin rivers and Delta hydrodynamics. The State Water Board did not solicit information on the need for water for other beneficial uses, including the amount of water needed for human health and safety, during the informational proceeding. Nor did the State Water Board consider other policy considerations, such as the state goal of providing a decent home and suitable living environment for every Californian.

Analytical Methods

The State Water Board received a wide range of recommendations for the volume, quantity and timing of flow necessary to protect public trust resources. Recommendations were also

received on non-flow related measures. State Water Board determinations of flow criteria rely upon four types of information:

- Unimpaired flows
- Historical impaired inflows that supported more desirable ecological conditions
- Statistical relationships between flow and native species abundance
- Ecological functions-based analysis for desirable species and ecosystem attributes

The State Water Board emphasizes, however, information based on ecological functions, followed by information on statistical relationships between flow and native species abundance.

In all cases, the flow criteria contained in this report are those supported by the best available scientific information submitted into the record for this proceeding. The conceptual bases for all of the criteria in this report are supported by scientific information on function-based species or ecosystem needs. In other words, there is sufficiently strong scientific evidence to support the need for flows necessary to support particular functions. This does not necessarily mean that there is scientific evidence to support *specific* numeric criteria. Criteria are therefore divided into two categories: Category "A" criteria have more and better scientific information, with less uncertainty, to support specific numeric criteria than do Category "B" criteria. The State Water Board followed the following steps to develop flow criteria and other measures:

1. Establish general goals and objectives for protection of public trust resources in the Delta
2. Identify species to include based on ecological, recreational, or commercial importance.
3. Review and summarize species life history requirements
4. Summarize numeric and other criteria for each of: Delta outflow, Sacramento River inflow, San Joaquin River inflow, and Hydrodynamics, including Old and Middle River flows
5. Review other flow-related and non-flow measures that should be considered
6. Provide summary determinations for flow criteria and other measures

In developing its flow criteria, the State Water Board reviewed the life history requirements of the following pelagic and anadromous species:

- Chinook Salmon (various runs)
- American Shad.
- Longfin Smelt
- Delta Smelt
- Sacramento Splittail
- Starry Flounder
- Bay Shrimp
- Zooplankton

The flow criteria needed to protect public trust resources are more than just the sum of each species-specific flow need. The State Water Board also considered the following issues to make its flow criteria determinations:

- Variability, flow paths, and the natural hydrograph
- Floodplain activation and other habitat improvements

- Water quality and contaminants
- Cold water pool management
- Adaptive management

The Board also made other specific determinations for other measures based on review of these issues.

Regulatory Authority of the State Water Board

The State Water Board was established in 1967 as the State agency with jurisdiction to administer California's water resources. The State Water Board is responsible for water allocation as well as for water quality planning and water pollution control. In carrying out its water quality planning functions under both State and federal law, the State Water Board formulates and adopts state policy for water quality control, which includes water quality principles and guidelines for long-range resource planning, water quality objectives, and other principles and guidelines deemed essential by the State Water Board for water quality control. The State Water Board has adopted a Water Quality Control Plan for the Delta (Bay-Delta Plan). The plan is implemented in part through conditions imposed in both water quality and water right permits.

The State Water Board administers the water rights program for the State, including issuing water right permits. More than two-thirds of the residents of California and more than two million acres of highly productive farmlands receive water exported from the Delta, primarily, although not exclusively, through the SWP and CVP. In addition to the SWP and CVP, there are many other diversions from the Delta and from tributaries to the Delta including the East Bay Municipal Utilities District, the San Francisco Public Utilities Commission, and Contra Costa Water District, to name a few.

Regulatory Actions by Other Agencies

In addition to the State Water Board, other state and federal agencies have authority to take regulatory action that can affect Delta inflows, outflows, and hydrodynamics. As indicated below, the United States Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS), and the California Department of Fish and Game (DFG) have authority to impose regulatory conditions that affect water diversions from the Delta. The Federal Energy Regulatory Commission (FERC) also has authority over non-federal hydropower projects that can change the timing and quantity of inflows to the Delta. Over the next six years, there are 16 hydropower projects on tributaries to the Sacramento and San Joaquin rivers with potential to affect Delta tributary flows that have ongoing or pending proceedings before the FERC.

Next Steps

The State Water Board will submit its flow criteria determinations to the Council for its information within 30 days of completing its determinations as required by Water Code section 85086.

The flow criteria contained in this report will be submitted to the Council to inform the Delta Plan. The Council is required to develop the Delta Plan to implement the State's co-equal goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The Council is to develop the Delta Plan by January 2012.

The flow criteria will also inform the BDCP. The BDCP is a multispecies conservation plan being developed pursuant to the ESA and the State Natural Community Conservation Planning Act (NCCPA), administered by the USFWS and the NMFS and the DFG, respectively. The

CESA and the federal ESA generally prohibit the "take" of species protected pursuant to the acts. Both acts contain provisions that allow entities to seek approvals from the resources agencies, which approvals allow limited take of protected species under some circumstances. The BDCP is intended to meet all regulatory requirements necessary for USFWS and NMFS to issue Incidental Take Permits to allow incidental take of all proposed covered species as a result of covered activities undertaken by DWR, certain SWP contractors, and Mirant Corporation, and to issue biological opinions under the ESA to authorize incidental take for covered actions undertaken by USBR and CVP contractors. The BDCP is also intended to address all of the requirements of the NCCPA for aquatic, wetland, and terrestrial covered species of fish, wildlife, and plants and Delta natural communities affected by BDCP actions and is intended to provide sufficient information for DFG to issue permits under the CESA for the taking of the species proposed for coverage under the BDCP.

Finally, the flow criteria in this report will also inform the State Water Board's on-going and subsequent proceedings, including the review and development of flow objectives in the San Joaquin River, a comprehensive update to the 2006 Bay-Delta Plan, and the associated water rights proceedings to implement these Bay-Delta Plan updates.

2. Introduction

The purpose of this report is to identify new flow criteria for the Sacramento-San Joaquin Delta (Delta) ecosystem to protect public trust resources in accordance with the Delta Reform Act of 2009, Water Code § 85000 et seq. The flow criteria, which do not have any regulatory or adjudicative effect, may be used to inform planning decisions for the new Delta Plan being prepared by the newly created Delta Stewardship Council (Council) and the Bay Delta Conservation Plan (BDCP). The public trust resources that are the subject of this proceeding include those resources affected by flow, namely, native and valued resident and migratory aquatic species, habitats, and ecosystem processes. The State Water Resources Control Board (State Water Board or Board) has developed flow criteria to protect these resources that incorporate measures regarding Delta outflows and Delta inflows and has recommended other measures relevant to the protection of public trust resources. After approval by the State Water Board, this report will be submitted to the Council.

3. Purpose and Background

3.1 Background and Scope of Report

Pursuant to Water Code section 85086, subdivision (c), enacted on November 12, 2009, in Senate Bill No. 1 of the 2009-2010 Seventh Extraordinary Session (Stats. 2009 (7th Ex. Sess.) ch. 5, § 39) (SB 1), the State Water Board is required to "develop new flow criteria for the Delta ecosystem necessary to protect public trust resources." The purpose of this report is to comply with the Legislature's mandate to the State Water Board.

Given the limited amount of time the State Water Board had to develop the criteria, the Board initially focused on Delta outflow conditions as a primary driver of ecosystem functions in the Delta. In determining the extent of protection to be afforded public trust resources through the development of the flow criteria, the State Water Board considered the broad goals of the planning efforts the criteria are intended to inform, including restoring and promoting viable, self-sustaining populations of aquatic species. The specific goals for protection are discussed in more detail below.

The notice for this proceeding focused the proceeding on Delta outflows. During the proceeding, however, the State Water Board received useful information from participants regarding Sacramento River inflows, San Joaquin River inflows, and Delta hydrodynamics (including Old and Middle River flows, San Joaquin River at Jersey Point flows, and San Joaquin River inflow to export ratios) that is relevant to protection of public trust resources in the Delta ecosystem. The hydrodynamic criteria included in this reportare largely dependent on exports and on San Joaquin River inflows, and do not directly affect the outflows considered in this proceeding. The State Water Board believes, however, that this information should be transmitted to the Council for its use in informing the Delta Plan and BDCP. Because the notice for the proceeding focused on Delta outflows, and some of the participants did not submit scientific information on inflows and hydrodynamics for the State Water Board's consideration, the record for inflows and hydrodynamics may not be as complete, and the analyses for these flow parameters accordingly may be limited. As a result, these criteria do not constitute formal criteria within the scope of the informational proceeding as noticed, but instead are submitted to the Council with the acknowledgement that they are based on the limited information received by the State Water Board.

3.1.1 The Legislative Requirements

In November 2009, legislation was enacted comprising a comprehensive water package for California. In general, the legislation is designed to achieve a reliable water supply for future generations and to restore the Delta and other ecologically sensitive areas. The package includes a bond bill and four policy bills, one of which is SB 1.

In the Delta Reform Act, the Legislature found and declared, among other matters, that:

> *"*The Sacramento-San Joaquin Delta watershed and California's water infrastructure are in crisis and existing Delta policies are not sustainable. Resolving the crisis requires fundamental reorganization of the state's management of Delta watershed resources. (Wat. Code, § 85001, subd. (a).)
>
> By enacting this division, it is the intent of the Legislature to provide for the sustainable management of the Sacramento-San Joaquin Delta ecosystem, to provide for a more reliable water supply for the state, to protect and enhance the quality of water supply from the Delta, and to establish a governance structure that will direct efforts across state agencies to develop a legally enforceable Delta Plan." (Wat. Code, § 85001, subd. (c).)

Among other provisions, SB 1 establishes the Delta Stewardship Council, which is charged with responsibility to develop, adopt, and commence implementation of a Delta Plan, a comprehensive, long-term management plan for the Delta, by January 1, 2012. The legislation also establishes requirements for inclusion of the BDCP, a multispecies conservation plan, into the Delta Plan. For purposes of informing the planning efforts for the Delta Plan and BDCP, SB 1 requires the State Water Board, pursuant to its public trust obligations, to develop new flow criteria for the Delta ecosystem necessary to protect public trust resources. (Wat. Code, § 85086, subd. (c).) Regarding the flow criteria, the Legislature provided that the flow criteria shall:

- include the volume, quality, and timing of water necessary for the Delta ecosystem;
- be developed within nine months of enactment of SB 1;

- be submitted to the Council within 30 days of completion;
- inform planning decisions for the Delta Plan and the BDCP;
- be based on a review of existing water quality objectives and the use of the best available scientific information;
- be developed in a public process by the State Water Board as a result of an informational proceeding conducted under the board's regulations set forth at California Code of Regulations, title 23, sections 649-649.5, in which all interested persons have an opportunity to participate.
- not be considered predecisional with regard to any subsequent State Water Board consideration of a permit, including any permit in connection with a final BDCP;
- inform any State Water Board order approving a change in the point of diversion of the State Water Project or the federal Central Valley Project from the southern Delta to a point on the Sacramento River;

3.1.2 The State Water Board's Public Trust Obligations

As stated above, SB 1 requires the State Water Board to develop new flow criteria to protect public trust resources in the Delta ecosystem pursuant to the Board's public trust obligations. The purpose of the public trust is to protect commerce, navigation, fisheries, recreation, ecological values, and fish and wildlife habitat. Under the public trust doctrine, the State of California has sovereign authority to exercise continuous supervision and control over the navigable waters of the state and the lands underlying those waters. (*National Audubon Society v. Superior Court* (*Audubon*) (1983) 33 Cal.3d 419.) A variant of the public trust doctrine also applies to activities that harm a fishery in non-navigable waters. (*People v. Truckee Lumber Co.* (1897) 116 Cal. 397, see *California Trout, Inc. v. State Water Resources Control Board* (1989) 207 Cal.App.3d 585, 630.)

In *Audubon*, the California Supreme Court held that California water law is an integration of the public trust doctrine and the appropriative water right system. (*Audubon*, *supra*, 33 Cal.3d at p. 426.) The state has an affirmative duty to take the public trust into account in the planning and allocation of water resources. The public trust doctrine requires the State Water Board to consider the effect of a diversion or use of water on streams, lakes, or other bodies of water, and "preserve, so far as consistent with the public interest, the uses protected by the trust." (*Audubon*, *supra*, 33 Cal.3d at p. 447.) Thus, before the State Water Board approves a water diversion, it must consider the effect of the diversion on public trust resources and avoid or minimize any harm to those resources where feasible. (*Id.* at p. 426.) Even after an appropriation has been approved, the public trust imposes a duty of continuing supervision. (*Id.* at p. 447.*)*

The purpose of this proceeding is to receive scientific information and develop flow criteria pursuant to the State Water Board's public trust obligations. In this forum, the State Water Board will not consider the allocation of water resources, the application of the public trust to a particular water diversion or use, or any balancing between potentially competing public trust resources. The State Water Board has also not considered minimum or maximum flows needed to protect public health and safety. Any such application of the State Water Board's public trust responsibilities, including any balancing of public trust values and water rights, would be conducted through an adjudicative or regulatory proceeding. Instead, the State Water Board's focus here is solely on identifying public trust resources in the Delta ecosystem within the scope of SB 1 and determining the flows necessary to protect those resources.

3.1.3 Public Process

The Water Code directs the State Water Board to develop the flow criteria in a public process in the form of an informational proceeding conducted pursuant to the Board's regulations. (Wat. Code, § 85086, subd. (c)(1); Cal. Code Regs., tit. 23, §§ 649-649.5.) The State Water Board conducted this informational proceeding to receive the best available scientific information to use in carrying out its mandate to develop new flow criteria for the Delta ecosystem necessary to protect public trust resources. (Wat. Code, § 85086, subd. (c)(1).) On December 16, 2009, the State Water Board issued the notice for the public informational proceeding to develop the flow criteria. For the informational proceeding, the State Water Board required the participants to submit a Notice of Intent to Appear by January 5, 2010. The State Water Board received 55 Notices of Intent to Appear for the informational proceeding.

On January 7, 2010, the State Water Board conducted a pre-proceeding conference to discuss the procedures for the informational proceeding mandated by Water Code section 85086, subdivision (c). Topics for the pre-proceeding conference included coordination of joint presentations, use of presentation panels, time limits on presentations, and electronic submittal of written information. The conference was used only to discuss procedural matters and did not address any substantive issues.

On January 29, 2010, the State Water Board issued a revised notice amending certain procedural requirements and posted a preliminary list of reference documents. Written testimony, exhibits, and written summaries, along with lists of witnesses and lists of exhibits, were due on February 16, 2010. The State Water Board gave participants and interested parties an opportunity to submit written questions regarding the written testimony, exhibits, and written summaries by March 9, 2010. All submittals were posted on the State Water Board's website.

On March 22 through 24, the State Water Board held the public informational proceeding to develop flow criteria for the Delta ecosystem. The State Water Board received a technical introduction by the Delta Environmental Flows Group (DEFG)[4] at the beginning of the proceeding. The group prepared two documents and an associated list of references that were submitted as State Water Board exhibits:

- Key Points on Delta Environmental Flows for the State Water Resources Control Board, February 2010
- Changing Ecosystems: a Brief Ecological History of the Delta, February 2010

A subset of the group, the UC Davis Delta Solutions Group, prepared three additional papers (which were also submitted as State Water Board exhibits):

- Habitat Variability and Complexity in the Upper San Francisco Estuary
- On Developing Prescriptions for Freshwater Flows to Sustain Desirable Fishes in the Sacramento-San Joaquin Delta

[4] The Delta Environmental Flows Group consists of William Bennett, Jon Burau, Cliff Dahm, Chris Enright, Fred Feyrer, William Fleenor, Bruce Herbold, Wim Kimmerer, Jay Lund, Peter Moyle, and Matthew Nobriga. This group of professors, researchers, and staff from various resource agencies was assembled by State Water Board staff with the intent of informing the Delta flow criteria informational proceeding.

- Ecosystem Investments for the Sacramento-San Joaquin Delta: Development of a Portfolio Framework

Over the course of the hearing, the State Water Board received information from expert witnesses in response to questions posed by Board members. The expert witnesses, representing various participants, as well as experts from the DEFG, were grouped into five panels in order to focus the discussions on specific aspects of the Delta flow criteria. These panels addressed the following topics: hydrology, pelagic fish, anadromous fish, other stressors, and hydrodynamics.

At the conclusion of the informational proceeding, participants were given approximately 20 days to submit closing comments. On July 21, 2010, the draft report was released for public review and comment.

3.1.4 Scope of This Report

Due to the limited nine-month time period in which the State Water Board must develop new flow criteria, the notice for the informational proceeding requested information on what volume, quality, and timing of Delta outflows are necessary under different hydrological conditions to protect public trust resources pursuant to the State Water Board's public trust obligations and the requirements of SB 1. Delta outflows are of critical importance to various ecosystem functions, water supply, habitat restoration, and other planning issues. The effect of Delta outflows in protecting public trust resources necessarily involves complex interactions with other flows in the Delta and with non-flow parameters including water quality and the physical configuration of the Delta. This report recognizes the role of source inflows used to meet Delta outflows, Delta hydrodynamics, tidal action, hydrology, water diversions, water project operations, and cold water pool storage in upstream reservoirs, and relies upon information submitted on these related topics to inform its determinations.

The State Water Board intends that the flow criteria developed in this proceeding should meet the following general goal regarding the protection of public trust resources:

- Halt the population decline and increase populations of native species as well as species of commercial and recreational importance by providing sufficient flow and water quality at appropriate times to promote viable life stages of these species.

To meet this goal, the State Water Board also sought to develop criteria that are comprehensive and that can be implemented without undue complexity. This report is limited to consideration of flow criteria needed under the existing physical conditions, so therefore does not consider or anticipate changes in habitat or modification of water conveyance facilities. The State Water Board does, however, identify other measures that should be considered in conjunction with, and to complement, the flow criteria.

A number of factors outside the scope of the legislative mandate to develop new flow criteria could affect public trust resources and some other factors could affect the interaction of flows with the environment. These factors include contaminants, water quality parameters, future habitat restoration measures, water conveyance facilities modification, and the presence of non-native species.

3.1.5 Concurrent State Water Board Processes

The State Water Board has a number of ongoing proceedings that may be informed by the development of flow criteria. Some of these proceedings will result in regulatory requirements

that affect flow, or otherwise affect the volume, quality, or timing of flows into, within, or out of the Delta. In July 2008, the State Water Board adopted a strategic work plan for actions to protect beneficial uses of the San Francisco Bay/Delta (Bay-Delta). In accordance with the work plan, the State Water Board recently completed a periodic review of the 2006 Water Quality Control Plan for the Bay-DeltaEstuary (Bay-Delta Plan) that recommended the Delta Outflow objectives, as well as other flow objectives, for further review in the water quality control planning process. Currently, the State Water Board is in the process of reviewing the southern Delta salinity and the San Joaquin River flow objectives contained in the Bay-Delta Plan.

Clean Water Act Water Quality Certifications

Several non-federal hydropower projects with potential to affect Delta tributary flows have ongoing or pending proceedings before the Federal Energy Regulatory Commission (FERC) that will result in the issuance of new licenses that will govern operations for the 30-50 year term. The relicensing process allows state and federal agencies to prescribe conditions to achieve certain objectives such as state water quality standards and the protection of listed species. New license conditions may include instreams flows requirements or other conditions to protect aquatic species. For example, the new license for the Oroville Dam will require changes in minimum flow requirements and changes in facilities and operations to meet certain water temperature requirements to protect Chinook salmon, steelhead, and green sturgeon. By 2016, more than 25 Delta tributary dams will go through the relicensing process.

The State Water Board will rely upon the FERC license application and the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) documents prepared for the projects, and may require submittal of additional data or studies, to inform its Clean Water Act Section 401 Water Quality Certifications for the projects. The Board's water quality certification will be issued as soon as possible after the environmental documents and any other needed studies are complete, after which FERC will issue a new license. The conditions in the water quality certification are mandatory and must be included in the FERC license.

Information developed as part of the relicensing of these projects will be used to inform on-going Bay Delta proceedings, and any information developed in the State Water Board's Bay Delta proceedings will be used to inform the two water quality certifications.

Table 1 summarizes the dams, tributaries, and license expiration dates for FERC projects in the Delta watershed. Several of these projects are upstream of major dams and reservoirs in the Sacramento and San Joaquin river watershed so operational changes would have little or no direct effect upon Delta flows.

Table 1. Delta Watershed FERC Projects

River	Dam(s)	Storage Capacity (acre-feet)	Owner	Status of Proceeding	FERC License Expiration
Feather	Oroville	3.5 million	Department of Water Resources (DWR)	Near completion	January 2007
West Branch Feather	Philbrook, Round Valley	6,200	Pacific Gas and Electric Company (PG&E)	Near Completion	October 2009
South Feather	Little Grass Valley	90,000	South Feather Water and Power Agency	Near completion	March 2009
Upper North Fork Feather	Lake Almanor	1.1 million	PG&E	Near Completion	October 2004
Pit River	McCloud, Iron Canyon,Pit 6, 7	110,000	PG&E	Ongoing	July 2011
North Yuba	New Bullards Bar	970,000	Yuba County Water Agency	Pre-Licensing meetings started	March 2016
Middle and South Yuba, Bear	Yuba-Bear Project, 10+ dams	210,000	Nevada Irrigation District	Ongoing	April 2013
Middle & South Yuba, Bear	Drum-Spaulding Project, 10+ dams	150,000	PG&E	Ongoing	April 2013
Middle Fork American River	French Meadows, Hell Hole	340,000	Placer County Water Agency	Ongoing	February 2013
South Fork American River	Loon Lake, Slab Creek	400,000	Sacramento Municipal Utility District	Near completion	July 2007
South Fork American River	Chili Bar	1,300	PG&E	Near completion	July 2007
Tuolumne	New Don Pedro	2 million	Turlock Irrigation District	To commence late 2010	April 2016
Merced	New Exchequer/ McSwain	1 million	Merced Irrigation District	Ongoing	February 2014
Merced	Merced Falls	650	PG&E	Ongoing	February 2014
San Joaquin	Mammoth Pool	120,000	Southern California Edison	Near Completion	November 2007
San Joaquin	Huntington, Shaver, Florence	320,000	Southern California Edison	Near Completion	February 2009

3.1.6 Delta Stewardship Council and Use of This Report

In accordance with the legislative requirements described above, the State Water Board will submit this report, containing its Delta flow criteria determinations, to the Council within 30 days after this report has been completed. This report will be deemed complete on the date the State Water Board adopts a resolution approving transmittal of the report to the Council.

Additionally, SB 1 requires any order approving a change in the point of diversion of the State Water Project (SWP) or the Central Valley Project (CVP) from the southern Delta to a point on the Sacramento River to include appropriate flow criteria and to be informed by the analysis in this report. (Wat. Code, § 85086, subd. (c)(2).) The statute also specifies, however, that the criteria shall not be considered predecisional with respect to the State Water Board's subsequent consideration of a permit. (*Id*., § 85086, subd. (c)(1).) Thus, any process with regulatory or adjudicative effect must take place through the State Water Board's water quality control planning or water rights processes in conformance with applicable law. Any person who wishes to introduce information produced during this informational proceeding, or the State Water Board's ultimate determinations in this report, into a later rulemaking or adjudicative proceeding must comply with the rules for submission of information or evidence applicable to that proceeding.

3.2 Regulatory Setting

3.2.1 History of Delta Flow Requirements

The State Water Rights Board (a predecessor to the State Water Board) first had an opportunity to consider flow requirements in the Delta when it approved water rights for much of the U.S. Bureau of Reclamation's (USBR) CVP in Water Right Decision 990 (D-990) (adopted in 1961), but it did not impose any fish protection conditions in D-990. In 1967, the State Water Rights Board included fish protections in D-1275 approving the water right permits for the SWP. Effective December 1, 1967, the State Water Rights Board and the State Water Quality Control Board were merged in a new agency, the State Water Board, which exercises both the water quality and water rights adjudicatory and regulatory functions of the state. The State Water Board adopted a new water quality control policy for the Delta and Suisun Marsh in October 1968, in Resolution 68-17. The resolution specified that the objectives would be implemented through conditions on the water rights of the CVP and SWP.

To implement the water quality objectives, the State Water Board adopted Water Right Decision 1379 (D-1379) in 1971[5]. D-1379 established new water quality requirements in both the SWP and CVP permits, including fish flows, and rescinded the previous SWP requirements from D-1275 and D-1291. D-1379 was stayed by the courts and eventually was superseded by Water Right Decision 1485 (D-1485).

In April 1973, in Resolution 73-16, the State Water Board adopted a water quality control plan to supplement the State water quality control policies for the Delta.

[5] In 1971, the State Water Board approved interim regional water quality control plans for the entire State, including the Delta and Suisun Marsh. Subsequently, the State Water Board approved long-term objectives for the Delta and Suisun Marsh in the regional plans for the Sacramento-San Joaquin Delta Basin and the San Francisco Bay Basin.

In August 1978, the State Water Board adopted both D-1485 and the 1978 Delta Plan. Together the 1978 Delta Plan and D-1485 revised existing objectives for flow and salinity in the Delta's channels and ordered USBR and DWR to meet the objectives. In 1987, the State Water Board commenced proceedings to review the 1978 Delta Plan and D-1485. The Board held a hearing at numerous venues in California and released a draft water quality control planin 1988, but subsequently withdrew it and resumed further proceedings.

In 1991, the State Water Board adopted the 1991 water quality control plan. This is the first Bay-Delta plan to adopt objectives for dissolved oxygen (DO) and temperature. The 1991 Bay-Delta plan did not amend either the flow or water project operations objectives adopted in the 1978 Delta Plan.[6] The United States Environmental Protection Agency (USEPA) approved the objectives in the plan for salinity for municipal, industrial, and agricultural uses, and approved the new DO objectives for fish and wildlife, but disapproved the Delta outflow objectives for the protection of fish and wildlife carried over from the 1978 Delta Plan. The USEPA adopted its own Delta outflow standards in 1994 to supersede the State's objectives.

In the summer of 1994, after the USEPA had initiated its process to develop standards for the Delta, the State and federal agencies with responsibility for management of Bay-Delta resources signed a Framework Agreement, agreeing that: (1) the State Water Board would update and revise its 1991 Bay-Delta Plan to meet federal requirements and would initiate a water right proceeding to implement the plan, after which the USEPA would withdraw its fish and wildlife objectives; (2) a group would be formed to coordinate operations of the SWP and CVP with all regulatory requirements in the Delta; and (3) the State and federal governments would undertake a joint long-term solution finding process to resolve issues in the Bay-Delta. In December 1994, representatives of the State and federal governments, water users, and environmental interests agreed to the implementation of a Bay-Delta protection plan. The plan and institutional documents to implement it are contained in a document titled "Principles for Agreement on Bay-Delta Standards between the State of California and the Federal Government." This is commonly referred to as the "Bay-Delta Accord" or "Principles Agreement."

In 1995 the State Water Board adopted the 1995 Bay-Delta Plan, which is consistent with the Principles Agreement.[7] In response to a water right change petition filed by DWR and USBR, the State Water Board then adopted Water Right orders that temporarily allowed DWR and USBR to operate the SWP and CVP in accordance with the 1995 Plan while the State Water Board conducted water right proceedings for a water right decision that would implement the 1995 Bay-Delta Plan. The hearing commenced in 1998 and concluded in 1999. During the 1998-99 water right hearing, DWR and USBR and their water supply contractors negotiated with a number of parties. In 1999, the State Water Board adopted Decision 1641 (D-1641) and subsequently revised D-1641 in 2000.

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[6] After adopting the 1991 Plan, the State Water Board conducted a proceeding to establish interim water right requirements for the protection of public trust uses in the Delta. The State Water Board released a draft water right decision known as "Decision 1630" (D-1630), but did not adopt it.

[7] USEPA approved the 1995 Bay-Delta Plan. By approving the 1995 Bay-Delta Plan, the USEPA supplanted its own water quality standards with the standards in the 1995 Bay-Delta Plan. (*State Water Resources Control Board Cases* (2006) 136 Cal.App.4th 674,774-775 [39 Cal.Rptr.3d 189]; 33 U.S.C. § 1313(c)(2)(A),(c)(3).)

3.2.2 Current State Water Board Flow Requirements

The current Bay-Delta flow requirements are contained in the 2006 Bay-Delta Plan and in D-1641. D-1641 implements portions of the 1995 Bay-Delta Plan. D-1641 accepts the contribution that certain entities, through their agreements, will make to meet the flow-dependent water quality objectives in the 1995 Plan, and continues the responsibility of DWR and USBR for the remaining measures to meet the flow-dependent objectives and other responsibilities. In addition, D-1641 recognizes the San Joaquin River Agreement (SJRA) and approves, for a period of twelve years, the conduct of the Vernalis Adaptive Management Plan (VAMP) under the SJRA instead of meeting the San Joaquin River pulse flow objectives in the 1995 Plan. The 2006 Bay-Delta Plan is consistent with D-1641 and makes only minor changes to the 1995 Bay-Delta Plan, allowing the staged implementation of the San Joaquin River spring pulse flow objectives and other minor changes. The 2006 Bay-Delta Plan also identifies a number of issues requiring additional review and planning including: the pelagic organism decline (POD), climate change, Delta and Central Valley salinity, and San Joaquin River flows.

Current Delta outflow requirements, set forth in Tables 3 and 4 in both the 2006 Bay-Delta Plan and D-1641, take two basic forms based on water year type and season: 1) specific numeric Delta outflow requirements; and 2) position of X2, the horizontal distance in kilometers up the axis of the estuary from the Golden Gate Bridge to where the tidally averaged near-bottom salinity is 2 practical salinity units (psu). The Delta outflow requirements are expressed in Table 3 as a Net Delta Outflow Index (NDOI). The NDOI is a calculated flow expressed as Delta Inflow, minus net Delta consumptive use, minus Delta exports. Each component is calculated as described in the 2006 Bay-Delta Plan and D-1641. An electrical conductivity (EC) measurement of 2.64 mmhos/cm at Collinsville station C2 can be substituted for the NDOI during February through June. The most downstream location of either the maximum daily average or the 14-day running average of this EC level is commonly referred to as the position of “X2” in the Delta. Table 4 specifies EC measurements at two specific locations and alternatively allows an NDOI calculation at these locations.

3.2.3 Special Status Species

The California Endangered Species Act (CESA) states that all native species of fishes, amphibians, reptiles, birds, mammals, invertebrates, and plants, and their habitats, threatened with extinction and those experiencing a significant decline which, if not halted, would lead to a threatened or endangered designation, will be protected or preserved. The federal Endangered Species Act of 1973 (ESA) provides for the conservation of species that are endangered or threatened throughout all or a significant portion of their range, and the conservation of the ecosystems on which they depend. A number of species discussed in this report are afforded protections under CESA and ESA. These species and the protections are discussed below.

The longfin smelt (*Spirinchus thaleichthys*) is currently a candidate for threatened species status under the CESA. (DFG 1, p. 9.) In March 2009, the California Fish and Game Commission (Commission) made a final determination that the listing of longfin smelt as a threatened species was warranted and the rulemaking process to officially add the species to the CESA list of threatened species found in the California Code of Regulations was initiated. Upon completion of this rulemaking process, the longfin smelt’s status will officially change from candidate to threatened. (DFG 1, p. 9.) Its status remains unresolved at the federal level. (USFWS 2009.) The delta smelt (*Hypomesus transpacificus*) is listed as endangered and threatened pursuant to the CESA and ESA, respectively. (DFG 1, p. 14; USFWS 1993.) In April 2010, the United States Fish and Wildlife Service (USFWS) considered a petition to reclassify the delta smelt from threatened to endangered. After review of all available scientific and

commercial information, the USFWS found that reclassifying the delta smelt from a threatened to an endangered species is warranted, but precluded by other higher priority listing actions. (USFWS 2010.)

Sacramento winter-run Chinook salmon *(Oncorhynchus tshawytscha)* is listed as endangered pursuant to the CESA and ESA. (NMFS 1994; NMFS 2005; DFG 2010.) Central Valley spring-run Chinook salmon (*O. tshawytscha*) is listed as threatened pursuant to both the CESA and ESA. (NMFS 1999; NMFS 2005; DFG 2010.) Central Valley fall/late fall-run Chinook salmon (*O. tshawytscha*) are classified as species of special concern by the National Marine Fisheries Service (NMFS). (NMFS 2004.) Central Valley steelhead (*O. mykiss*) is listed as threatened under the ESA (NMFS 1998; NMFS 2006a.) Southern Distinct Population Segment of North American green sturgeon (*Acipenser medirostris*) is listed as threatened under the ESA. (NMFS 2006b.)

3.2.4 State Incidental Take Permit for Longfin Smelt

The CESA prohibits the take[8] of any species of wildlife designated as an endangered, threatened, or candidate species[9] by the Commission. The Department of Fish and Game (DFG), however, may authorize the take of such species by permit if certain conditions are met (Cal. Code Regs., tit 14, § 783.4). In 2009, DFG issued an Incidental Take Permit for Longfin Smelt to the DWR for the on-going and long-term operation of the SWP. The permit specifies a number of conditions, including two flow measures (Conditions 5.1 and 5.2) intended to minimize take of the longfin smelt and provide partial mitigation for the remaining take by: 1) minimizing entrainment; 2) improving estuarine processes and flow; 3) improving downstream transport of longfin smelt larvae; and 4) providing more water that is used as habitat (increasing habitat quality and quantity) by longfin smelt than would otherwise be provided by the SWP.

Longfin Smelt Incidental Take Permit (2009), p. 9-10, Condition 5.1.
This Condition is not likely to occur in many years. To protect adult longfin smelt migration and spawning during December through February period, the Smelt Working Group (SWG) or DFG SWG personnel staff shall provide Old and Middle River (OMR) flow advice to the Water Operations Management Team (WOMT) and to Director of DFG weekly. The SWG will provide the advice when either: 1) the cumulative salvage index (defined as the total longfin smelt salvage at the CVP and SWP in the December through February period divided by the immediately previous FMWT longfin smelt annual abundance index) exceeds five (5); or 2) when a review of all abundance and distribution survey data and other pertinent biological factors that influence the entrainment risk of adult longfin smelt indicate OMR flow advise is warranted. Permittee shall ensure the OMR flow requirement is met by maintaining the OMR flow 14-day running average is no more negative than -5,000 cfs and the initial 5-day running average is not more negative than -6,250 cfs. During any time OMR flow restrictions for the USFWS's 2008 Biological Opinion for delta smelt are being implemented, this condition (5.1) shall not result in additional OMR flow requirements for protection of adult longfin smelt. Once spawning has been detected in the system, this Condition terminates and 5.2 begins. Condition 5.1 is not required or would cease if previously required when river flows are 1) > 55,000 cfs in

[8] Pursuant to Fish and Game Code section 86, "'Take' means hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture or kill."

[9] "Candidate species" are species of wildlife that have not yet been placed on the list of endangered species or the list of threatened species, but which are under formal consideration for listing pursuant to Fish and Game Code section 2074.2

the Sacramento River at Rio Vista; or 2) > 8,000 cfs in the San Joaquin River at Vernalis. If flows go below 40,000 cfs in the Sacramento River at Rio Vista or 5,000 cfs in the San Joaquin River at Vernalis, the OMR flow in Condition 5.1 shall resume if triggered previously. Review of survey data and other pertinent biological factors that influence the entrainment risk of adult longfin smelt may result in a recommendation to relax or cease an OMR flow requirement.

Longfin Smelt Incidental Take Permit (2009), p. 10-11, Condition 5.2.
To protect larval and juvenile longfin smelt during January -June period, the SWG or DFG SWG personnel shall provide OMR flow advice to the WOMT and the DFG Director weekly. The OMR flow advice shall be an OMR flow between -1,250 and -5,000 cfs and be based on review of survey data, including all of the distributional and abundance data, and other pertinent biological factors that influence the entrainment risk of larval and juvenile longfin smelt. When a single Smelt Larval Survey (SLS) or 20 mm Survey sampling period results in: 1) longfin smelt larvae or juveniles found in 8 or more of the 12 SLS or 20mm stations in the central and south Delta (Stations 809, 812, 901, 910, 912, 918, 919) or, 2) catch per tow exceeds 15 longfin smelt larvae or juveniles in 4 or more of the 12 survey stations listed above, OMR flow advice shall be warranted. Permittee shall ensure the OMR flow requirement is met by maintaining the OMR flow 14-day running average no more negative than the required OMR flow and the 5-day running average is within 25% of the required OMR. This Conditions OMR flow requirement is likely to vary throughout Jan through June. Based on prior analysis, DFG has identified three likely scenarios that illustrate the typical entrainment risk level and protective measures for larval smelt over the period: High Entrainment Risk Period - Jan through Mar OMR range from -1,250 to -5,000 cfs; Medium Entrainment Risk Period - April and May OMR range from -2000 to -5,000 cfs, and Low Entrainment Risk Period - June OMR -5,000 cfs. When river flows are: 1) greater than 55,000 cfs in the Sacramento River at Rio Vista; or 2) greater than 8,000 cfs in the San Joaquin River at Vernalis, the Condition would not trigger or would be relaxed if triggered previously. Should flows go below 40,000 cfs in Sacramento River at Rio Vista or 5,000 cfs in the San Joaquin River at Vernalis, the Condition shall resume if triggered previously. In addition to river flows, the SWG or DFG SWG personnel review of all abundance and distribution survey data and other pertinent biological factors that influence the entrainment risk of longfin smelt may result in a recommendation by DFG to WOMT to relax or cease an OMR flow requirement.

3.2.5 Biological Opinions

In 2008 and 2009, the USBR and the DWR concluded consultations regarding the effects of continued long-term operations of the Central CVP and SWP with the USFWS and the NMFS, respectively. Those consultations led to the issuance of biological opinions that require implementation of reasonable and prudent alternatives (RPAs) to avoid jeopardizing the continued existence and potential for recovery of delta smelt (*Hypomesus transpacificus*), Sacramento River winter-run Chinook salmon *(Oncorhynchus tshawytscha)*, Central Valley spring-run Chinook salmon (*O. tshawytscha*), Central Valley steelhead (*O. mykiss*), Southern Distinct Population Segment of North American green sturgeon (*Acipenser medirostris*), and Southern Resident killer whales *(Orcinus orca)*.

Pursuant to Section 7 of the ESA, federal agencies must insure that their actions do not jeopardize the continued existence of threatened or endangered species or adversely modify their designated critical habitat. The regulations (50 CFR 402.02) implementing Section 7 of the ESA define RPAs as alternative actions, identified during formal consultation, that: 1) can be implemented in a manner consistent with the intended purpose of the action; 2) can be implemented consistent with the scope of the action agency's legal authority and jurisdiction; 3) are economically and technologically feasible; and, 4) would, the USFWS or NMFS believes,

avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat. (USFWS 2008, p.279.)

Numerous anthropogenic and other factors (e.g., pollutants and non-native species) that may adversely affect listed fish species in the region are not under the direct control of the CVP or the SWP and as such are not addressed in the biological opinions.

USFWS Biological Opinion

On December 15, 2008, the USFWS issued a biological opinion on the Long-Term Operational Criteria and Plan (OCAP) for coordination of the CVP and SWP (UFWS Opinion). The RPA in the USFWS Opinion, divided into six actions, applies to delta smelt and focuses primarily on managing flow regimes to reduce entrainment of delta smelt and on the extent of suitable water conditions in the Delta, as well as on construction or restoration of habitat. (USFWS 2008, pp.329-381.) Flow related components of the RPA include:

- A fixed duration action to protect pre-spawning adult delta smelt from entrainment during the first flush, and to provide advantageous hydrodynamic conditions early in the migration period. This action limits exports so that the average daily net OMR flow is no more negative than -2,000 cubic-feet per second (cfs) for a total duration of 14 days, with a 5-day running average no more negative than -2,500 cfs (within 25 percent) (Action 1, p.329).

- An adaptive process to continue to protect pre-spawning adults from entrainment and, to the extent possible, from adverse hydrodynamic conditions after the action identified above. The range of net daily OMR flows will be more no more negative than -1,250 to -5,000 cfs. From the onset of this action through its termination, the Delta Smelt Working Group would provide weekly recommendations for specific net OMR flows based upon review of the sampling data, from real-time salvage data at the CVP and SWP, and utilizing the most up-to-date technological expertise and knowledge relating population status and predicted distribution to monitored variables of flow and turbidity. The USFWS will make the final determination (Action 2, p.352).

- Upon completion of Actions 1 and 2 or when Delta water temperatures reach 12°C (based on a 3-station average of daily average water temperature at Mossdale, Antioch, and Rio Vista) or when a spent female delta smelt is detected in the trawls or at the salvage facilities, the projects shall operate to maintain net OMR flows no more negative than -1,250 to -5000 cfs based on a 14-day running average with a simultaneous 5-day running average within 25% of the applicable 14-day OMR flow requirement. Action continues until June 30th or when Delta water temperatures reach 25˚C, whichever comes first (Action 3, p.357).

- Improve fall habitat, both quality and quantity, for delta smelt through increasing Delta outflow during fall (fall X2). Subject to adaptive management, provide sufficient Delta outflow to maintain average X2 for September and October no greater (more eastward) than 74 km in the fall following wet years and 81km in the fall following above normal years. The monthly average X2 must be maintained at or seaward of these values for each individual month and not averaged over the two month period. In November, the inflow to CVP/SWP reservoirs in the Sacramento Basin will be added to reservoir releases to provide an added increment of Delta inflow and to augment Delta outflow up

- To minimize entrainment of larval and juvenile delta smelt at the State and federal south Delta export facilities or from being transported into the south and central Delta, where they could later become entrained, do not install the Head of Old River Barrier (HORB) if delta smelt entrainment is a concern. If installation of the HORB is not allowed, the agricultural barriers would be installed as described in the Project Description of the biological opinion. If installation of the HORB is allowed, the Temporary Barrier Project flap gates would be tied in the open position until May 15 (Action 5, p. 377).

- Implement habitat restoration activities designed to improve habitat conditions for delta smelt by enhancing food production and availability to supplement the benefits resulting from the flow actions described above. DWR shall implement a program to create or restore a minimum of 8,000 acres of intertidal and associated subtidal habitat in the Delta and Suisun Marsh. The restoration efforts shall begin within 12 months of signature of this biological opinion and be completed within a 10 year period (Action 6, p. 379).

NMFS Biological Opinion

On June 4, 2009, NMFS issued its Biological and Conference Opinion on the OCAP (NMFS Opinion), which provides RPA actions to protect winter-run and spring-run Chinook salmon, Central Valley steelhead, green sturgeon, and killer whales from project effects in the Delta and upstream areas. (NMFS 3.) The RPA consists of five actions with a total of 72 subsidiary actions. Included within the RPA are actions related to: formation of technical teams, research and adaptive management, monitoring and reporting, flow management, temperature management, gravel augmentation, fish passage and reintroduction, gate operations and installation (Red Bluff Diversion Dam, Delta Cross Channel Gate, South Delta Improvement Program), funding for fish screening, floodplain and other habitat restoration, hatchery management, export restrictions, CVP and SWP fish collection facility modifications, and fish collection and handling. The flow related components of the opinion include:

- In the Sacramento River Basin – flow requirements for Clear Creek; release requirements from Whiskeytown Dam for temperature management; cold water pool management of Shasta Reservoir; development of flow requirements for Wilkins Slough; and restoration of floodplain habitat in the lower Sacramento River basin to better protect Chinook salmon, steelhead, and green sturgeon. (*Id at* pp.587-611.)

- In the American River - flow requirements and cold water pool management requirements to provide protection for steelhead. (*Id at* pp. 611-619.)

- In the San Joaquin River Basin – cold water pool management, floodplain inundation flows, and flow requirements for the Stanislaus River (NMFS 3, pp. 619-628, Appendix 2-E) and an interim minimum flow schedule for the San Joaquin River at Vernalis during April and May effective through 2011 for the protection of steelhead. (*Id at* pp. 641-645.)

- In the Delta – Delta Cross-Channel Gate operational requirements; net negative flow requirements toward the export pumps in Old and Middle rivers; and export limitations based on a ratio of San Joaquin River flows to combined SWP and CVP export during April and May for the protection of Chinook salmon and steelhead. (*Id. at* pp. 628-660.)

It is important to note that the flow protections described in the project description and RPA are the minimum flows necessary to avoid jeopardy. (NMFS written summary, p.3.) In addition, NMFS considered provision of water to senior water rights holders to be non-discretionary for purposes of the ESA as it applies to Section 7 consultation with the USBR, which constrained development of RPA Shasta storage actions and flow schedules. San Joaquin River flows at Vernalis were constrained by the NMFS Opinion's scope extending only to CVP New Melones operations. Operations on other San Joaquin tributaries were not within the scope of the consultation. (*Id.*)

Recent Litigation

Both the USFWS Opinion and the NMFS Opinion are the subject of ongoing litigation in the United States District Court for the Eastern District of California. Plaintiffs challenged the validity of the opinions under various legal theories, including claims under the ESA and the NEPA. Most recently, this year plaintiffs Westlands Water District and San Luis Delta Mendota Water Authority sought preliminary injunctions against the implementation of certain RPAs identified by NMFS and USFWS in their biological opinions for the protection of Delta smelt and Central Valley steelhead and salmonids. In May 2010, Judge Wanger issued a ruling concluding that injunctive relief was appropriate with respect to the NMFS biological opinion PRA Action IV.2.1, which limits pumping based on San Joaquin River inflow from April 1 through May 31, and RPA Action IV.2.3, which imposes restrictions on negative OMR flows in generally between January 1 and June 15. Later that month, he also ruled that injunctive relief was appropriate with respect to RPA Component 2 of Action 3 of the USFWS Opinion, which requires net OMR flows to remain between -1,250 and -5,000 cfs during a certain period for the protection of larval and juvenile delta smelt. The validity of the biological opinions likely will continue to be litigated in the foreseeable future, creating uncertainty about implementation of the RPAs.

3.3 Environmental Setting

Figure 1 is a map of the Bay-Delta Estuary that was included in the 2006 Bay-Delta Plan. The map depicts the location of monitoring stations used to collect baseline water quality data for the Bay-Delta Estuary and stations used to monitor compliance with water quality objectives set forth in the Bay-Delta Plan.

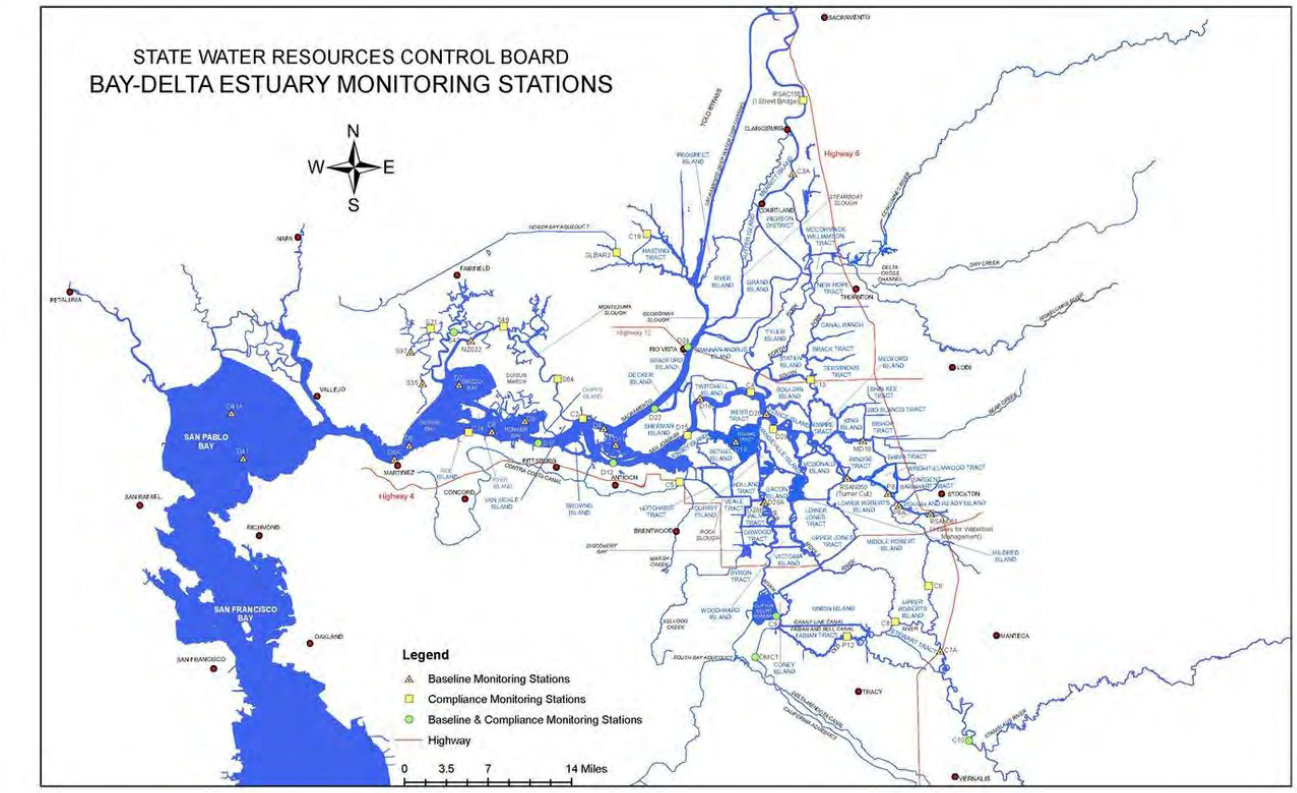


Figure 1. Map of the Bay-Delta Estuary

3.3.1 Physical Setting

The Delta is located where California's two major river systems, the Sacramento and San Joaquin rivers, converge from the north and south and are joined by several tributaries from the Central Sierras to the east, before flowing westward through the San Francisco Bay to the Pacific Ocean. The Sacramento and San Joaquin rivers drain water from the Central Valley Basin, which includes about 40 percent of California's land area.

Outflow from the Delta enters Suisun Bay just west of the confluence of the Sacramento and San Joaquin rivers. Suisun Marsh, which is located along the north shore of Suisun Bay, is one of the few major marshes remaining in California and is the largest remaining brackish wetland in Western North America. The marsh is subject to tidal influence and is directly affected by Delta outflow. Suisun Marsh covers approximately 85,000 acres of marshland and water ways and provides a unique diversity of habitats for fish and wildlife.

The Old Delta

The Delta formed as a freshwater marsh through the interaction of river inflow and the strong tidal influence of the Pacific Ocean and San Francisco Bay. The growth and decay of tules and other marsh plants resulted in the deposition of organic material, creating layers of peat that formed the soils of the marsh. Hydraulic mining during the Gold Rush era washed large amounts of sediment into the rivers, channels and bays, temporarily burying the wetlands. The former wetland areas were reclaimed into more than 60 islands and tracts that are devoted primarily to farming. A network of levees protects the islands and tracts from flooding, because most of the islands lie near or below sea level due to the erosion and oxidation of the peat soils.

As shown in Figure 2 (Courtesy, Chris Enright, DWR, using Atwater data), prior to reclamation, the channels in the Delta were connected in a dendritic, or tree-like, pattern and may have included 5 to 10 times as many miles of interconnected channels as it does today, with largely unidirectional flow.



Figure 2. The Old Delta (*ca.* 1860).

The Recent Delta

Today's Delta covers about 738,000 acres, of which about 48,000 acres are water surface area, and is interlaced with about 700 miles of waterways. As shown in Figure 3 (Courtesy, Chris Enright, DWR, using Atwater data), today's remaining Delta waterways have been greatly modified to facilitate the bi-directional movement of water and the river banks have been armored to protect against erosion, thus changing the geometry of the stream channels and eliminating most of the natural vegetation and habitat of the aquatic and riparian environment. The interconnected geometry and channelized sloughs of the present Delta result in much less variability in water quality than the past dendritic pattern, and today's mostly open ended sloughs results in water quality and habitat being relatively homogenous throughout the system. (Moyle et al. 2010.)



Figure 3. The Recent Delta

The Changing Delta

The Delta Environmental Flows Group (DEFG 2) describes in *Changing Ecosystems: a Brief Ecological History of the Delta* how the Delta has undergone significant physical and biological modification over the past 150 years. Initial development occurred during the Gold Rush when large amounts of sediment washed into the Delta, followed by diking and dredging of rivers. This was followed by increasing diversions and developments, including fixing of levees and channels, and most recently with large-scale dam development and diversions from the Delta. The Moyle et al. history also suggests what is likely to happen in the future:

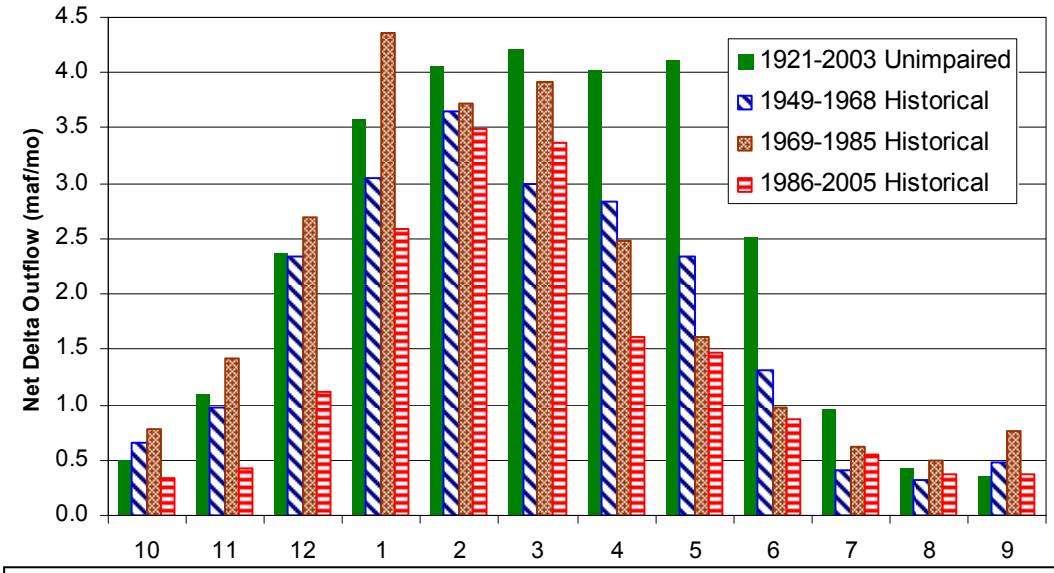
> "The Delta ecosystem is likely to dramatically shift again within 50 years due to large-scale levee collapse in the Delta and Suisun Marsh. Major levee failures are inevitable due to continued subsidence, sea level rise, increasing frequency of large floods, and high probability of earthquakes. These significant changes will create large areas of open water and increased salinity intrusion, as well as new tidal and subtidal marshes. Other likely changes include reduced freshwater inflow during prolonged droughts, altered hydraulics from reduced export pumping, and additional alien invaders (e.g., zebra and quagga mussels). The extent and effects of all these changes are unknown but much will depend on how the estuary is managed in response to change or even before change takes place. Overall, these major changes in the estuary's landscape are likely to promote a more variable, heterogeneous estuary, especially in the Delta and Suisun Marsh. This changed environment is likely to be better for desirable estuarine species; at least it is unlikely to be worse."

3.3.2 Hydrology/Hydrodynamics

California's climate and hydrology are Mediterranean, which is characterized by most precipitation falling during the winter-spring wet season, a dry season extending from late spring through early fall, and high inter-annual variation in total runoff. The life history strategies of all native estuarine Delta fishes are adapted to natural variability. (Moyle and Bennett 2008, as cited in Fleenor et al. 2010.) Although the unimpaired flow record does not indicate precise, or best, flow requirements for fish under current conditions, the general timing (e.g., seasonality), magnitudes, and directions of flows seen in the unimpaired flow record are likely to remain important for native species under contemporary and future conditions. (Fleenor et al. 2010.)

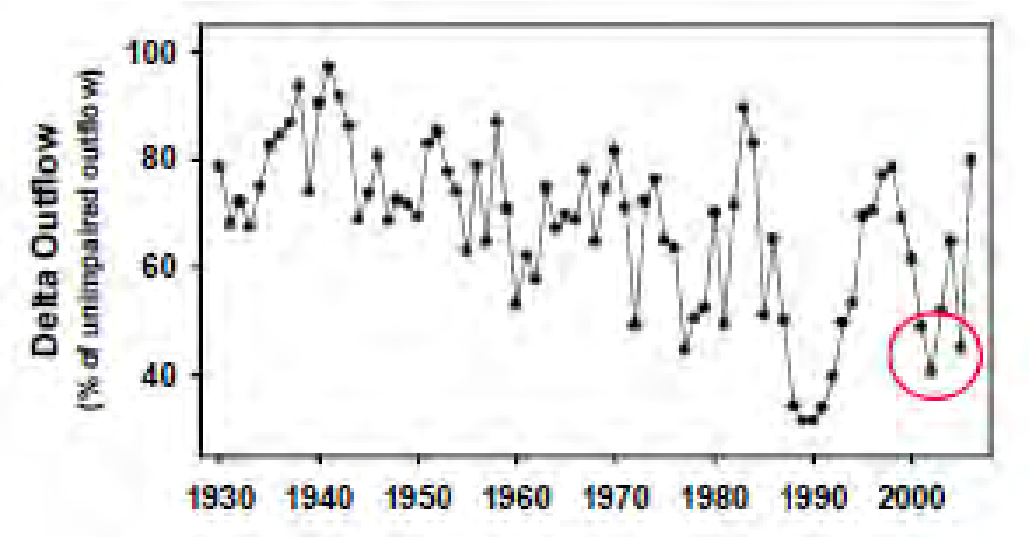
Inflow to the Delta comes primarily from the Central Valley Basin's Sacramento and San Joaquin river systems and is chiefly derived from winter and spring runoff originating in the Cascade and Sierra Nevada mountains, with minor amounts from the Coast Ranges. Precipitation totals vary annually with about 80 percent of the total occurring between the end of October and the beginning of April. Snow storage in the high Sierra delays the runoff from that area until the snow melts in April, May, and June. Normally, about half of the annual runoff from the Central Valley Basin occurs during this period. In recent years, the Sacramento River contributed roughly 75 to 80% of the Delta inflow in most years, while the San Joaquin River contributed about 10 to 15%. The minor flows of the Mokelumne, Cosumnes, and Calaveras rivers, which enter into the eastern side of the Delta, contributed the remainder of the inflow to the Delta.

Net Delta outflow represents the difference between the sum of freshwater inflows from tributaries to the Delta and the sum of exports and net in-Delta consumptive uses. (Kimmerer 2004, DOI 1, p.17.) As noted above, the majority of the freshwater flow into the Delta occurs in winter and spring; however, upstream storage and diversions have reduced the winter-spring flow and increased flow in summer and early fall. (Figure 4, Kimmerer 2002b; Kimmerer 2004; DOI 1, p. 16.) The April-June reductions are largely the result of the San Joaquin River diversions. (Fleenor et al. 2010.) During the summer-fall dry season the Delta channels essentially serve as a conveyance system for moving water from reservoirs in the north to the CVP and SWP export facilities, as well as the smaller Contra Costa Water District facility, for subsequent delivery to farms and cities in the San Joaquin Valley, southern California, and/or other areas outside the watershed. (Kimmerer 2002b.) Figure 5 shows the reduction in annual Delta outflow as a percentage of unimpaired outflow. The combined effects of water exports and upstream diversions reduced average annual net outflow from the Delta from unimpaired conditions by 33% and 48% during the 1948 – 1968 and 1986 – 2005 periods, respectively. (Fleenor et al. 2010.)



This figure shows monthly average net delta outflows (in million acre-feet per month) compared to the unimpaired flows from 1921-2003. Unimpaired flow data is from DWR (2006) and other from Dayflow web site. (Source: Fleenor et al. 2010, Figure 7.)

Figure 4. Monthly Average Net Delta Outflows from Fleenor et al. 2010

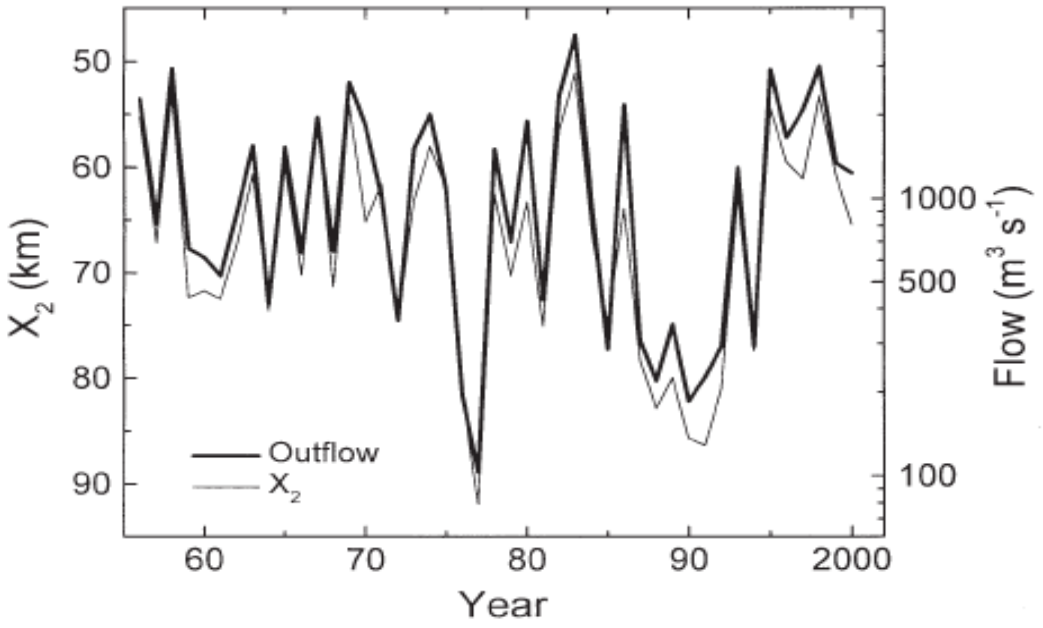


Delta outflow shown as a percentage of unimpaired outflow (1930-2005); in the last decade annual outflow is reduced by more than 50% in 2001, 2002, and 2005. (Source: TBI 2007, as cited in DOI 1, p. 17.)

Figure 5. Delta Outflow as a Percent of Unimpaired Outflow from TBI 2007

Delta outflows and the position of X2 are closely and inversely related, with a time lag of about two weeks. (Jassby et al. 1995; Kimmerer 2004.) A time series of the annual averages for January to June of X2 and Delta outflow is depicted in Figure 6. X2 is defined as the horizontal distance in kilometers up the axis of the estuary from the Golden Gate Bridge to where the tidally averaged near-bottom salinity is 2 practical salinity units (psu). (Jassby et al. 1995,

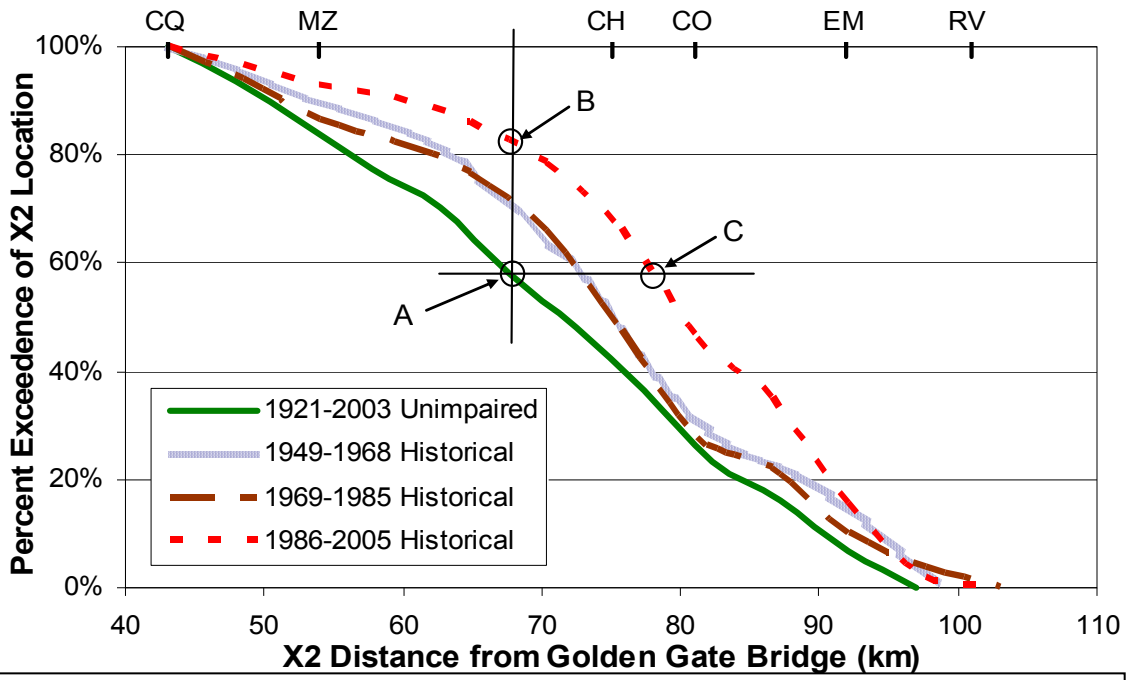
Kimmerer 2002a.) The position of X2 roughly equates to the center of the low salinity zone (defined as salinity of 0.5 to 6 psu). (Kimmerer 2002a.) The X2 objectives in the 2006 Bay-Delta Plan were designed to restore a more natural hydrograph and salinity pattern by requiring maintenance of the low salinity zone at specified points and durations based on the previous month's Eight River Index. (State Water Board 2006a.) The relationships between outflow and several measures of the health of the Bay-Delta Estuary have been known for some time (Jassby *et al*. 1995) and are the basis for the current X2 objectives.



Time series of X2 (thin line, left axis, scale reversed) and flow (heavy line, right axis, log scale), annual averages for January to June; flow data from DWR; X2 calculated as in Jassby et al. (1995) (Source: Kimmerer 2002a, Figure 3).

Figure 6. X2 and Delta Outflow for January to June from Kimmerer 2002a

Both Delta outflow and the position of X2 have been altered as a result of numerous factors including development and operation of upstream storage and diversions, land use changes, and increasing water demand. Hydrodynamic simulations conducted by Fleenor et al. (2010) indicate that the position of X2 has been skewed eastward in the recent past, as compared to unimpaired conditions and earlier impaired periods, and that the variability of salinity in the western Delta and Suisun Bay has been significantly reduced (Figure 7). The higher X2 values shown in this figure (refer to Point 'B') indicate the low salinity zone is farther upstream for a more prolonged period of time. Point 'B' demonstrates that during the period from 1986 to 2005 the position of X2 was located upstream of 71 km nearly 80% of the time, as opposed to unimpaired flows which were equally likely to place X2 upstream or downstream of the 71 km location (50% probability). (Fleenor *et al*. 2010.) Historically, X2 exhibited a wide seasonal range tracking the unimpaired Delta outflows; however, seasonal variation in X2 range has been reduced by nearly 40%, as compared to pre-dam conditions. (TBI 2003, as cited in DOI 1, pp. 21-22.)



This graph shows the cumulative probability distributions of daily X2 locations showing unimpaired flows (green solid line) and three historical periods, 1949-1968 (light solid blue line), 1969-1985 (long-dashed brown line) and 1986-2005 (short-dashed red line), illustrating progressive reduction in salinity variability from unimpaired conditions. Paired letters indicate geographical landmarks: CQ, Carquinez Bridge; MZ, Martinez Bridge; CH, Chipps Island; CO, Collinsville; EM, Emmaton; and RV, Rio Vista (Source: Fleenor et al. 2010, Figure 8).

Figure 7. Cumulative Probability of Daily X2 Locations from Fleenor *et al*. 2010

In their key points on Delta environmental flows for the State Water Board, the DEFG (DEFG 1) noted that the recent flow regimes both harm native species and encourage non-native species and provided the following justification:

> "The major river systems of the arid western United States have highly variable natural flow regimes. The present-day flow regimes of western rivers, including the Sacramento and San Joaquin, are highly managed to increase water supply reliability for agriculture, urban use, and flood protection (Hughes et al. 2005, Lund et al. 2007). Recent Delta inflow and outflow regimes appear to both harm native species and encourage non-native species. Inflow patterns from the Sacramento River may help riverine native species in the north Delta, but inflow patterns from the San Joaquin River encourage non-native species. Ecological theory and observations overwhelmingly support the argument that enhancing variability and complexity across the estuarine landscape will support native species. However, the evidence that flow stabilization reduces native fish abundance in the upper estuary (incl. Delta) is circumstantial:
>
> 1) High winter-spring inflows to the Delta cue native fish spawning migrations (Harrell and Sommer 2003; Grimaldo et al. 2009), improve the reproductive success of resident native fishes (Meng et al. 1994; Sommer et al. 1997; Matern et al. 2002; Feyrer 2004), increase the survival of

juvenile anadromous fishes migrating seaward (Sommer *et al*. 2001; Newman 2003), and disperse native fishes spawned in prior years (Feyrer and Healey 2003; Nobriga et al. 2006).

2) High freshwater outflows (indexed by X2) during winter and spring provide similar benefits to species less tolerant of freshwater including starry flounder, bay shrimp, and longfin smelt (Kimmerer 2002; Kimmerer *et al*. 2009). Freshwater flows provide positive benefits to native fishes across a wide geographic area through various mechanisms including larval-juvenile dispersal, floodplain inundation, reduced entrainment, and increased up-estuary transport flows. Spring Delta inflows and outflow have declined since the early 20th century, but average winter-spring X2 has not had a time trend during the past 4-5 decades (Kimmerer 2004).

3) The estuary's fish assemblages vary along the salinity gradient (Matern et al. 2002; Kimmerer 2004), and along the gradient between predominantly tidal and purely river flow. In tidal freshwater regions, fish assemblages also vary along a gradient in water clarity and submerged vegetation (Nobriga et al. 2005; Brown & Michniuk 2007), and smaller scale, gradients of flow, turbidity, temperature and other habitat features (Matern et al. 2002; Feyrer & Healey 2003). Generally, native fishes have their highest relative abundance in Suisun Marsh and the Sacramento River side of the Delta, which are more spatially and temporally variable in salinity, turbidity, temperature, and nutrient concentration and form than other regions.

4) In both Suisun Marsh and the Delta, native fishes have declined faster than non-native fishes over the past several decades (Matern et al. 2002; Brown and Michniuk 2007). These declines have been linked to persistent low fall outflows (Feyrer et al. 2007) and the proliferation of submerged vegetation in the Delta (Brown and Michniuk 2007). However, many other factors also may be influencing native fish declines including differences in sensitivity to entrainment (sustained or episodic high "fishing pressure" as productivity declines), and greater sensitivity to combinations of food-limitation and contaminants, especially in summer-fall when many native fishes are near their thermal limits.

The weight of the circumstantial evidence summarized above strongly suggests flow stabilization harms native species and encourages non-native species, possibly in synergy with other stressors such as nutrient loading, contaminants, and food limitation."

Diversion and Use

Irrigation is the primary use of water in the Sacramento and San Joaquin river watershed. Water is used to a lesser extent to meet municipal, industrial, environmental, and instream needs. Water is also exported from the Central Valley Basin for many of these same purposes. Local irrigation districts, municipal utility districts, county agencies, private companies and corporations, and State and federal agencies have developed surface water projects throughout the basin to control and conserve the natural runoff and provide a reliable water supply for beneficial uses. Many of these projects are used to produce hydroelectric power and to

enhance recreational opportunities. Flood control systems, water storage facilities, and diversion works exist on all major streams in the basin, altering the timing, location, and quantity of water and the habitat associated with the natural flow patterns of the basin. (State Water Board 1999.)

The major surface water supply developments of the Central Valley include the CVP, other federal projects built by the USBR and the U.S. Army Corps of Engineers (USACE), the SWP, and numerous local projects (including several major diversions). The big rim dams, developed mostly since the 1940s, dramatically changed river flow patterns. The dams were built to provide flood protection and a reliable water supply. Collection of water to storage decreased river flows in winter and spring, and changed the timing of high flow periods (except for extreme flood flows). The San Joaquin River has lost most of its natural summer flows because the majority of the water is exported via the Friant project or diverted from the major tributaries for use within the basin. Even though natural flows have been substantially reduced, agricultural return flows during the summer have actually resulted in higher flows than would have occurred under unimpaired conditions at times. Winter and spring flows collected to storage by the State and federal projects in the Sacramento Basin are released in the late spring and throughout the summer and fall, largely to be rediverted from the Delta for export. The federal pumping plants in the southern Delta started operating in the 1950s, exporting water into the Delta-Mendota Canal. The State pumps and the California Aqueduct started operating in the late 1960s, further increasing exports from the Delta. (Moyle, et al. 2010.)

In-Delta Diversions and Old and Middle River Reverse Flows

The USBR and the DWR are the major diverters in the Delta. The USBR exports water from the Delta at the Tracy Pumping Plant and the Contra Costa Water District diverts CVP water at Rock Slough and Old River under a water supply contract with the USBR. The DWR exports from the Delta at the Banks Delta Pumping Plant and Barker Slough to serve the SWP contractors. Operation of the CVP and SWP Delta export facilities are coordinated to meet water quality and flow standards set by the Board, the USACE, and by fisheries agencies. In addition, there are approximately 1,800 local diversions within the Delta that amount to a combined potential instantaneous flow rate of more than 4,000 cfs. (State Water Board 1999.)

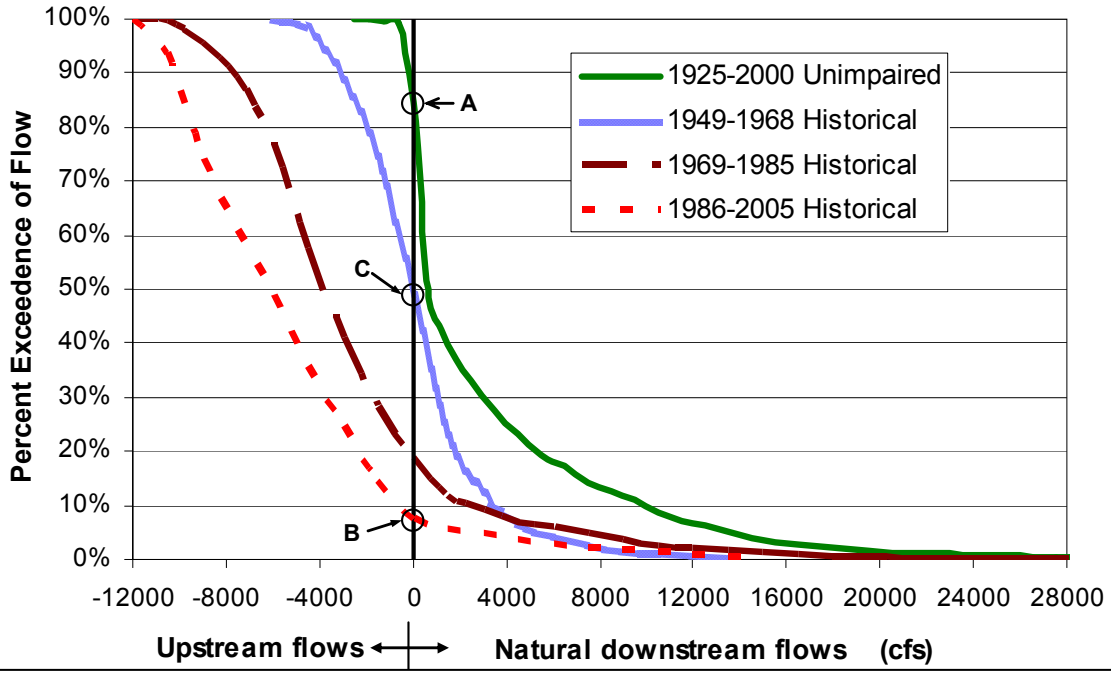
Net OMR reverse flows are now a regular occurrence in the Delta (Figure 8). Net OMR reverse flows are caused by the fact that the major freshwater source, the Sacramento River, enters on the northern side of the Delta while the two major pumping facilites, the SWP and CVP, are located in the south (Figure 1). This results in a net water movement across the Delta in a north-south direction along a web of channels including Old and Middle rivers instead of the more natural pattern from east to west or from land to sea. Net OMR is calculated as half the flow of the San Joaquin River at Vernalis minus the combined SWP and CVP pumping rate. (CCWD closing comments, p. 2.) A negative value, or a reverse flow, indicates a net water movement across the Delta along Old and Middle river channels to the State and Federal pumping facilities. Fleenor *et al* (2010) has documented the change in both the magnitude and frequency of net OMR reverse flows as water development occurred in the Delta (Figure 8). The 1925-2000 unimpaired line in Figure 8 represents the best estimate of “quasi-natural” or net OMR values before most modern water development. (Fleenor et al. 2010.) The other three lines represent changes in the frequency and magnitude of net OMR flows with increasing development. Net OMR reverse flows are estimated to have occurred naturally about 15% of the time before most modern water development, including construction of the major pumping facilities in the South Delta (point A, Figure 8). The magnitude of net OMR reverse flows was seldom more negative than a couple of thousand cfs. In contrast, between1986-2005 net OMR

reverse flows had become more frequent than 90 percent of the time (Point B). The magnitude of net OMR reverse flows may now be as much as -12,000 cfs. High net OMR reverse flows have several negative ecological consequences. First, net reverse OMR flows draw fish, especially the weaker swimming larval and juvenile forms, into the SWP and CVP export facilities. The export facilities have been documented to entrain most species of fish present in the upper estuary. (Brown *et al*. 1996,.) Approximately 110 million fish were salvaged at the SWP pumping facilities and returned to the Delta over a 15 year period, (Brown et al. 1996.) However, this number underestimates the actual number of fish entrained, as it does not include losses at the CVP nor does it account for fish less than 20 mm in length which are not collected and counted at the fish collection facilities. Second, net OMR reverse flows reduce spawning and rearing habitat for native species, like delta smelt. Any fish that enters the Central or Southern Delta has a high probability of being entrained and lost at the pumps. (Kimmerer and Nobriga, 2008.) This has restricted their habitat to the western Delta and Suisun and Grizzly bays. Third, net OMR reverse flows have led to a confusing environment for migrating juvenile salmon leaving the San Joaquin Basin. Through-Delta exports reduce salinity in the central and southern Delta and as a result juvenile salmon migrate from higher salinity in the San Joaquin River to lower salinity in the southern Delta, contrary to the natural historical conditions and their inherited migratory cues. Finally, net OMR reverse flows reduce the natural variability in the Delta by drawing Sacramento River water across and into the Central Delta. The UC Davis Delta Solutions Group recommends:

> "Achieving a variable, more complex estuary requires establishing seaward gradients in salinity and other water quality variables These goals in turn encourage policies which establish internal Delta flows that create a tidally-mixed, upstream-downstream gradient (without cross-Delta flows) in water quality and restoring environmental variability in the Delta is fundamentally inconsistent with continuing to move large volumes of water through the Delta for export. The drinking and agricultural water quality requirements of through-Delta exports, and perhaps even some current in-Delta uses, are at odds with the water quality and variability needs of desirable Delta species."
> (Moyle et al., 2010.)

Net OMR reverse flow restrictions are included in the USFWS Opinion (Actions 1 through 3), the NMFS Opinion (Action IV.2.3), and the DFG Incidental Take Permit (Conditions 5.1 and 5.2) for the protection of delta smelt, salmonids, and longfin smelt, respectively. (NMFS 3. p. 648; USFWS 2008, DFG 2009.) Additional net OMR reverse flow restrictions are recommended in this report for protection of longfin and delta smelt and Chinook salmon.

Further north in the Delta, the Delta Cross Channel is used to divert a portion of the Sacramento River flow into the interior Delta channels. The purpose of the Delta Cross Channel is to preserve the quality of water diverted from the Sacramento River by conveying it to southern Delta pumping plants through eastern Delta channels rather than allowing it to flow through more saline western Delta channels. The Delta Cross Channel is also operated to protect fish and wildlife beneficial uses (specifically Chinook salmon), while recognizing the need for fresh water to be moved through the system. With a capacity of 3,500 cfs, the Delta Cross Channel can divert a significant portion of the Sacramento River flows into the eastern Delta, particularly in the fall.



Cumulative probability distribution of sum of Old and Middle River flows (cfs) resulting from through Delta conveyance showing unimpaired flows (green solid line) and three historical periods, 1949-1968 (solid light blue line), 1969-1985 (long-dashed brown line) and 1986-2005 (short-dashed red line) (Source: Fleenor et al. 2010, Figure 9).

Figure 8. OMR Cumulative Probability Flows from Fleenor et al. 2010

3.3.3 Water Quality

Water quality in the Delta may be negatively impacted by contaminants in sediments and water, low DO levels, and blue green algal blooms. Additionally, changes in hydrology and hydrodynamics affect water quality. The conversion of tidal wetlands to leveed Delta islands has altered the tidal exchange and prism. These changes can contribute to spatial and temporal shifts in salinity and other physical and chemical water quality parameters (temperature, DO, contaminants, etc.).

Contaminants

The Delta and San Francisco Bay are listed under section 303(d) of the Federal Clean Water Act as impaired for a variety of toxic contaminants that may contribute to reduced population abundance of important fish and invertebrates. The contaminants include: organophosphate and pyrethrin pesticides, mercury, selenium and unknown toxicity. In addition, low DO levels periodically develop in the San Joaquin River in the Stockton Deep Water Ship Channel (DWSC) and in Old and Middle rivers. The low DO levels in the DWSC inhibit the upstream migration of adult fall-run Chinook salmon and adversely impact other resident aquatic organisms. The Central Valley and San Francisco Regional Boards are systematically developing Total Maximum Daily Loads (TMDLs) for all listed pollutants and adopting programs to implement control actions.

There is concern that a number of non-303(d) listed contaminants, such as ammonia, pharmaceuticals, endocrine disrupting compounds and blue-green algal blooms could also limit biological productivity and impair beneficial uses. More work is needed to determine their

impact on the aquatic community. Sources of these contaminants include: agricultural, municipal, and industrial wastewater; urban storm water discharges; discharges from wetlands; and channel dredging activities.

Ammonia has emerged as a contaminant of special concern in the Delta. Recent hypotheses are that ammonia is causing toxicity to delta smelt, other local fish, and zooplankton, and is reducing primary production rates in the Sacramento River below the Sacramento Regional Wastewater Treatment Plant (SRWTP) and in Suisun Bay. A third, newer, hypothesis is that ammonia and nitrogen to phosphorus ratios have altered phytoplankton species composition, and these changes have had a detrimental effect on zooplankton and fish population abundance. (Glibert, 2010.)

The SRWTP is the primary source of ammonia to the Delta. (Jassby 2008.) The SRWTP has converted the Delta from a nitrate to an ammonia dominated nitrogen system. (Foe et al. 2010.) Seven-day flow-through bioassays by Werner et al. (2008, 2009) have demonstrated that ammonia concentrations in the Delta are not acutely toxic to delta smelt. Monthly nutrient monitoring by Foe *et al*. (2010) has demonstrated that ammonia concentrations are below the recommended USEPA (1999) chronic criterion for the protection of juvenile fish. Results from the nutrient monitoring suggest that ammonia-induced toxicity to fish is not regularly occurring in the Delta.

Elevated ammonia concentrations inhibit nitrate uptake and that appears to be one factor preventing spring diatom blooms from developing in Suisun Bay. (Dugdale et al. 2007; Wilkerson et al. 2006.) One of the primary hypotheses for the POD is a decrease in the availability of food at the base of the food web. (Sommer et al. 2007.) Staff from the San Francisco Regional Board has informed the Central Valley Regional Board that ammonia may be impairing aquatic life beneficial uses in Suisun Bay (letter to Kathy Harder with the Central Valley Regional Board from Bruce Wolfe of the San Francisco Regional Board dated June 4, 2010).

Ammonia concentrations are higher in the Sacramento River below the SRWTP than in Suisun Bay. This led to a hypothesis that ammonia might be inhibiting nitrate uptake and reducing primary production rates in the Sacramento River and downstream Delta, as occurs in Suisun Bay. Experimental results for the Sacramento River are more ambiguous than for Suisun Bay. (Parker *et al*., 2010.) Five-day cubitainer grow out experiments conducted using water collected above and below the SRWTP usually demonstrated more chlorophyll in water collected below the SRWTP. Short-term bottle primary production rate measurements conducted using water collected above and below the SRWTP also demonstrate no decrease in the rate when normalized by the amount of chlorophyll in the bottle. However, effluent dosed into upstream Sacramento River water at environmentally realistic concentrations does show a decrease in primary production. Elevated ammonia concentrations consistently decrease nitrate uptake. Whether the shift in nitrogen utilization indicates that different algal species are beginning to grow in the ammonia rich water is not known. A recent paper by Glibert (2010) demonstrates significant correlations between the form and concentration of nutrients discharged by the SRWTP, and changes in phytoplankton, zooplankton, and fish abundance in the Delta.

Salinity

Elevated salinity can impair the uses of water by municipal, industrial, and agricultural users and by organisms that require lower salinity levels. There are at least three factors that may cause salinity levels to exceed water quality objectives in the Delta: saltwater intrusion from the Pacific

Ocean and San Francisco Bay moving into the Delta on high tides during periods of relatively low flows of fresh water through the Delta; salts from agricultural return flows, municipalities, and other sources carried into the southern and eastern Delta with the waters of the San Joaquin River; and localized increases in salinity due to irrigation return flows into dead-end sloughs and low-capacity channels (null zones). The effects of saltwater intrusion are seen primarily in the western Delta. Due to the operation of the State and federal export pumping plants near Tracy, the higher salinity areas caused by salts in the San Joaquin River tend to be restricted to the southeast corner of the Delta. Null zones, and the localized areas of increased salinity associated with them, exist predominantly in three areas of the Delta: Old River between Sugar Cut and the CVP intake; Middle River between Victoria canal and Old River; and the San Joaquin River between the head of Old River and the City of Stockton.

Suspended Sediments and Turbidity

Turbidity in the Delta is caused by factors that include suspended material such as silts, clays, and organic matter coming from the major tributary rivers; planktonic algal populations; and sediments stirred up during dredging operations to maintain deep channels for shipping. Turbidity affects large river and estuarine fish assemblages because some fishes survive best in turbid (muddy) water, while other species do best in clear water. Studies suggest that changes in specific conductance and turbidity are associated with declines in upper estuary habitat for delta smelt, striped bass, and threadfin shad. Laboratory studies have shown that delta smelt require turbidity for successful feeding.

Turbidity in the Delta has decreased through time. The primary hypotheses to explain the turbidity decrease are: (1) reduced sediment supply; (2) sediment washout from very high inflows during the 1982 to 1983 El Nino; and (3) trapping of sediment by submerged aquatic vegetation. (Wright and Schoellhamer 2004, Jassby et al. 2005, Nobriga et al. 2005, and Brown and Michniuk 2007 as cited in Nobriga et al. 2008.)

Dissolved Oxygen

Low DO levels are found along the lower San Joaquin River and in certain localized areas of the Delta. Dissolved oxygen impairment is caused, in part, by loads of oxygen demanding substances such as dead algae or waste discharges. Low DO in the Delta occurs mainly in the late summer and coincides with low river flows and high temperatures. Fish vary greatly in their ability to tolerate low DO concentrations, based on the environmental conditions the species has evolved to inhabit. Salmonids are relatively intolerant of low DO concentrations. Within the lower San Joaquin River, DO concentrations can become sufficiently low to impair the passage and/or cause mortality of migratory salmonids. (DFG 3, p. 3; DOI 1, p. 25; TBI/NRDC 3, p. 26.)

The DWSC is a portion of the lower San Joaquin River between the City of Stockton and the San Francisco Bay that has been dredged to allow for the navigation of ocean-going vessels to the Port of Stockton. A 14-mile stretch of the DWSC, from the City of Stockton to Disappointment Slough, is listed as impaired for DO and, at times, does not meet the objectives set forth in the San Joaquin Riverwater quality control plan. Studies have identified three main contributing factors to the problem: loads of oxygen demanding substances that exert an oxygen demand (particularly the death and decay of algae); DWSC geometry, which reduces the assimilative capacity for loads of oxygen demanding substances by reducing the efficiency of natural re-aeration mechanisms and by magnifying the effect of oxygen demanding reactions; and, reduced flow through the DWSC, which reduces the assimilative capacity by reducing upstream inputs of oxygen and increasing the residence time for oxygen demanding reactions. (Central Valley Regional Board 2003.)

3.3.4 Biological Setting

The Bay-Delta Estuary is one of the largest, most important estuarine systems for fish and waterfowl production on the Pacific Coast of the United States. The Delta provides habitat for a wide variety of freshwater, estuarine, and marine fish species. Channels in the Delta range from dead-end sloughs to deep, open water areas that include several flooded islands that provide submerged vegetative shelter. The complex interface between land and water in the Delta provides rich and varied habitat for wildlife, especially birds. The Delta is particularly important to waterfowl migrating via the Pacific Flyway as these birds are attracted to the winter-flooded fields and seasonal wetlands. (State Water Board 1999.)

Existing Setting

A wide variety of fish are found throughout the waterways of the Central Valley and the Bay-Delta Estuary. About 90 species of fish are found in the Delta. Some species, such as the anadromous fish, are found in particular parts of the Bay-Delta Estuary and the tributary rivers and streams only during certain stages of their life cycle. The Delta's channels serve as a migratory route and nursery area for Chinook salmon, striped bass, white and green sturgeon, American shad, and steelhead trout. These anadromous fishes spend most of their adult lives either in the lower bays of the estuary or in the ocean, moving inland to spawn. Resident fishes in the Bay-Delta Estuary include delta smelt, longfin smelt, threadfin shad, Sacramento splittail, catfish, largemouth and other bass, crappie, and bluegill.

Food supplies for Delta fish communities consist of phytoplankton, zooplankton, benthic invertebrates, insects, and forage fish. The entrapment zone, where freshwater outflow meets and mixes with the more saline water of the Bay, concentrates sediments, nutrients, phytoplankton, some fish larvae, and other fish food organisms. Biological standing crop (biomass) of phytoplankton and zooplankton in the estuary has generally been highest in this zone. However, the overall productivity at the lower trophic levels has decreased over time. (State Water Board 1999.)

Non-Native and Invasive Species

Invasive aquatic organisms are known to have deleterious effects on the Delta ecosystem. These effects include reductions in habitat suitability, reductions in food supply, alteration of the aquatic food-web, and predation on or competition with native species. There are many notable examples of exotic species invasions in the Bay-Delta, so much so, that the Delta has been labeled "the most invaded estuary on earth."

Of particular importance potentially in the recent decline in pelagic organisms is the introduction of the Asian clam, *Corbula amurensis*. The introduction of the clam has lead to substantial declines in the lower trophic production of the Bay-Delta Estuary. In addition to reductions in planktonic production caused by *Corbula*, the planktonic food web composition has changed dramatically over the past decade or so. Once dominant copepods in the food web have declined leading to speculation that estuarine conditions have changed to favor alien species. The decrease in these desirable copepods may further increase the likelihood of larval fish starvation or result in decreased growth rates. (State Water Board 2008.)

The proliferation of invasive, aquatic weeds, such as *Egeria densa*, which filter out particulate materials and further reduce planktonic growth, are also having a impact on the Bay-Delta. Areas with low or no flow, such as warm, shallow, dead-end sloughs in the eastern Delta also support objectionable populations of plants during summer months including planktonic blue-green algae and floating and semi-attached aquatic plants such as water primrose, water

hyacinth, and *Egeria densa*. All of these plants contribute organic matter that reduces DO levels in the fall, and the floating and semi-attached plants interfere with the passage of small boat traffic. In addition, native fishes in the Bay-Delta face growing challenges associated with competition and predation by non-native fish. (State Water Board 1999; State Water Board 2008.)

Recent Species Declines

Historical fisheries within the Central Valley and the Bay-Delta Estuary were considerably different than the fisheries present today. Many native species have declined in abundance and distribution, while several introduced species have become well established. The Sacramento perch is believed to have been extirpated from the Delta; however, striped bass and American shad are introduced species that, until recently, have been relatively abundant and have contributed substantially to California's recreational fishery. (State Water Board 1999.)

In 2005, scientists with the Interagency Ecological Program (IEP) announced observations of a precipitous decline in several pelagic organisms in the Delta, beginning in 2002, in addition to declining levels of zooplankton. Zooplankton are the primary food source for older life stages of species such as delta smelt. The decline in pelagic organisms included delta smelt, striped bass, longfin smelt, and threadfin shad. Scientists hypothesized that at least three general factors may be acting individually, or in concert, to cause this recent decline in pelagic productivity: 1) toxic effects; 2) exotic species effects; and 3) water project effects. Scientists and resources agencies have continued to investigate the causes of the decline, and have prepared plans that identify actions designed to help stabilize the Delta ecosystem and improve conditions for pelagic fish species. (State Water Board 2008.)

In January of 2008, the Pacific Fisheries Management Council reported unexpectedly low Chinook salmon returns to California, particularly to the Central Valley, for 2007. Adult returns to the Sacramento River, the largest of Central Valley Chinook salmon runs, failed to meet resource management goals (122,000-180,000 spawners) for the first time in 15 years. (State Water Board 2008.) The Sacramento River fall Chinook salmon escapement to the Central Valley was estimated to be 88,000 adults in 2007; 66,000 in 2008; and 39,530 – the lowest on record -- in 2009. (PCFFA 2.) The NMFS concluded that poor ocean conditions were a major factor contributing to the low fall-run abundance; however, other conditions may exacerbate these effects. (State Water Board 2008.)

In April 2008, the Pacific Fisheries Management Council and the Commission adopted the most restrictive ocean and coastal salmon seasons ever for California by closing the ocean and coastal fishery to commercial and recreation fishing for the 2008 fishing season. The Commission further banned salmon fishing in all Central Valley rivers, with the exception of limited fishing on a stretch of the Sacramento River. (State Water Board 2008.) The ban on all salmon fishing was extended through the 2009 season, but the restrictions were eased somewhat for 2010.

3.3.5 How Flow-Related Factors Affect Public Trust Resources

Flow is important to sustaining the ecological integrity of aquatic ecosystems, including the public trust resources that are the subject of this proceeding. Flow affects water quality, food resources, physical habitat, and biotic interactions. Alterations in the natural flow regime affect aquatic biodiversity and the structure and function of aquatic ecosystems.

In its key points on Delta environmental flows for the State Water Board, the DEFG (DEFG 1) noted that:

- Flow related factors that affect public trust resources include more than just volumes of inflow and outflow and no single rate of flow can protect all public trust resources at all times. The frequency, timing, duration, and rate of change of flows, the tides, and the occurrence of overbank flows, all are important. Seasonal, interannual, and spatial variability in flows, to which native species are adapted, are as important as the quantity of flow. Biological responses to flows rest on combinations of quantity, timing, duration, frequency and how these inputs vary spatially in the context of a Delta that is geometrically complex, highly altered by humans, and fundamentally tidally driven.

- Recent flow regimes in the Delta have contributed to the decline of native species and encouraged non-native species. Flows into and within the estuary affect turbidity, salinity, aquatic plant communities, and nutrients that are important to both native and non-native species. However, flows and habitat structure are often mismatched and now favor non-native species.

- Flow is a major determinant of habitat and transport. The effects of flow on transport and habitat are controlled by the geometry of the waterways. Further, because the geometry of the waterways will change through time, flow regimes needed to maintain desired habitat conditions will also change through time. Delta inflow is an important factor affecting the biological resources of the Delta because inflow has a direct effect on flood plain inundation, in-Delta net channel flows, and net Delta outflows.

- Flow modification is one of the few immediate actions available to improve conditions to benefit native species. However, habitat restoration, contaminant and nutrient reduction, changes in diversions, control of invasive species, as well as flood plain inundation and island flooding all interact with flow to affect aquatic habitats.

4. Methods and Data

The notice for the informational proceeding requested scientific information on the volume, quality, and timing of water needed for the Delta ecosystem under different hydrologic conditions to protect public trust resources pursuant to the State Water Board's public trust obligations and the requirements of SB 1. Specifically, the notice focused on Delta outflows, but also requested information concerning the importance of the source of those flows and information concerning adaptive management, monitoring, and special study programs. In addition to the requested information concerning Delta outflows, the State Water Board also received information on Sacramento River inflows, San Joaquin River inflows, hydrodynamics including Old and Middle River flows, and other information that is relevant to protection of public trust resources in the Delta ecosystem. This section presents the recommendations received by the State Water Board and discusses approaches used to evaluate the recommendations and develop flow criteria responsive to SB1.

4.1 Summary of Participants' Submittals

Information submitted by interested parties over the course of this proceeding has resulted in the development of a substantive record; submittals are available on the State Water Board's website at:
http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/entity_index.shtml

The exhibits include discussions pertaining to: the State Water Board's public trust obligations; methodologies that should be used to develop flow criteria; the importance of the source of flows when determining outflows; means by which uncertainty should be addressed; and specific recommendations concerning Delta outflows, Sacramento and San Joaquin river inflows, hydrodynamics, operation of the Delta Cross Channel Gates, and floodplain activation.

The State Water Board received a wide range of recommendations for the volume, quantity and timing of flow necessary to protect public trust resources. Delta outflow recommendations ranged from statements that the current state of scientific understanding does not support development of numeric Delta flow criteria that differ from the current outflow objectives included in D-1641 (DWR closing comments; SFWC closing comments) to flow volumes during above normal and wet water year types that are two to four times greater than currently required under D-1641 (TBI/NRDC closing comments; AR/NHI closing comments; EDF closing comments, CSPA closing comments; CWIN closing comments). Appendix A: Summary of Participant Recommendations, provides summary tables of the recommendations received for Delta outflows, Sacramento River inflows, San Joaquin River inflows, hydrodynamics, floodplain inundation, and Delta Cross Channel Gate closures.

4.2 Approach to Developing Flow Criteria

Fleenor et al. (2010) examined the following four approaches for prescribing environmental flows for the Delta:

- Unimpaired (quasi-natural) inflows
- Historical impaired inflows that supported more desirable ecological conditions
- Statistical relationships between flow and native species abundance
- The appropriate accumulation of flows estimated to provide specific ecological functions for desirable species and ecosystem attributes based on available literature.

Fleenor *et al*. (2010) concludes:

> "Generally, approaches that rely on data from the past will become more risky as the underlying changes in the Delta accumulate. However, since the objective is to provide flows for species which evolved under past conditions, information on past flows and life history strategies of fish provide considerable insight and context. Aggregate statistical approaches, which essentially establish correlations between past conditions and past species abundance, are likely to be less directly useful as the Delta changes. However, statistical approaches will continue to be useful, especially if developed for causal insights. More focused statistical relationships can be of more enduring value in the context of more causal models, even given underlying changes. In the absence of more process-based science, empirical relationships might be required for some locations and functions on an interim basis. Insights and information can be gained from each approach. Given the importance of the problem and the uncertainties involved,

the strengths of each approach should be employed to provide greater certainty or improve definition of uncertainties."

Among other things, the Fleenor report recommends:

1. Flow prescriptions should be supported preferably by causally or process-based science, rather than correlative empirical relationships or other statistical relationships without supporting ecological basis. Having a greater causal basis for flow prescriptions should make them more effective and readily adapted to improvements in knowledge and changing conditions in the Delta. A more explicit causal basis for flow prescriptions will also create incentives for improved scientific understanding of this system and its management as well as better integration of physical, chemical, and biological aspects of the problem.
2. Ongoing managed and unmanaged changes in the Delta will make any static set of flow standards increasingly irrelevant and obsolete for improving conditions for native fishes. Flows should be tied to habitat, fish, hydrologic, and other management conditions, as well as our knowledge of the system. Flows needed for fish native to the Delta will change.

Information received during this proceeding supports these conclusions and recommendations. The record for this proceeding contains a mix of data and analyses that uses the four approaches identified by Fleenor et al. (2010):

- Unimpaired flows
- Historical impaired inflows that supported more desirable ecological conditions
- Statistical relationships between flow and native species abundance
- Ecological functions-based analysis for desirable species and ecosystem attributes

All four types of information are relied upon to develop the flow criteria in this report. Emphasis, however, is placed on ecological function-based information, followed by information on statistical relationships between flow and native species abundance. In all cases, the criteria are supported by the best available scientific information submitted into the record for this proceeding. The species and ecosystem function-based needs assessments and criteria in this report are supported by references to specific scientific and empirical evidence, and cite to exhibits and testimony in the record or conclusions in published and peer reviewed articles. Criteria based upon statistical relationships between flow and native species abundance are also supported by references to specific scientific and empirical evidence, and cite to exhibits and testimony in the record or conclusions in published and peer reviewed articles.

Furthermore, the conceptual bases for all of the criteria in this report are supported by scientific information on function-based species or ecosystem needs. In other words, there is sufficiently strong scientific evidence to support the need for functional flows. This does not necessarily mean that there is scientific evidence to support *specific* numeric criteria. Recommendations are therefore divided into two categories: Category "A" criteria have more and better scientific information, with less uncertainty, to support specific numeric criteria than do Category "B" criteria. In all cases, the assumptions upon which the criteria are based are identified and discussed. The following steps were followed to develop flow criteria and other recommendations:

1. Establish general goals and objectives for protection of public trust resources in the Delta
2. Identify species to include based on ecological, recreational, or commercial importance
3. Review and summarize species life history requirements, including description of:
    - general life history and species needs
    - population distribution and abundance
    - population abundance and relationship to flow
    - specific population goals
    - species-specific basis for flow criteria
4. Summarize numeric and other criteria for each of: Delta outflows, Sacramento River inflows, San Joaquin River inflows, and hydrodynamics
5. Review other flow-related and non-flow measures that should be considered
6. Provide summary determinations for flow criteria and other measures

The following information was assembled and considered for each species, if available in the record for this proceeding:

- Life history information including timing of migrations
- Seasons or time periods when flow characteristics are most important
- Relationships of species abundance or habitat to Delta outflows, Delta inflows, hydrodynamics, or water quality parameters linked to flow, etc.
- Species environmental requirements (e.g., DO, temperature preferences, salinity, X2 location, turbidity, toxicity to specific pollutants, etc.)
- Relationship of species abundance to invasive species, to the extent possible
- Key quantifiable population responses or habitat characteristics linked to flow
- Mechanisms or hypotheses about mechanisms that link species abundance, habitat, and other metrics to flow or other variables

4.2.1 Biological and Management Goals

The goal of this report is discussed in Section 3.1.4 (Scope of this Report). The following biological and management goals are used to guide the development of criteria that support species life history requirements.

Biological Goals

- Depending on water year type or hydrologic condition, provide sufficient flow to increase abundance of desirable species that depend on the Delta (longfin smelt, delta smelt, starry flounder, bay shrimp, American shad, and zooplankton).

- Create shallow brackish water habitat for longfin smelt, delta smelt, starry flounder, bay shrimp, American shad, and zooplankton in Suisun Bay (and farther downstream).

- Provide floodplain inundation of appropriate timing and sufficient duration to enhance spawning and rearing opportunities to support Sacramento splittail, Chinook salmon, and other native species.

- Manage net OMR reverse flows and other hydrodynamic conditions to protect sensitive life stages of desirable species.

- Provide sufficient flow in the San Joaquin River to transport salmon smolts through the Delta during spring in order to contribute to attainment of the State Water Board's salmon protection water quality objective. (2009 Bay-Delta Plan, p. 14.)

- Provide sufficient flow in the Sacramento River to transport salmon smolts through the Delta during the spring in order to contribute to the attainment of the salmon protection water quality objective. (*Id.*)

- Provide sufficient flow in eastside streams that flow to the Delta, including the Mokelumne and Consumes rivers, to transport salmon smolts to the Delta during the spring in order to contribute to the attainment of the salmon protection water quality objective.

- Maintain water temperatures and DO in mainstem rivers that flow into the Delta and their tributaries at levels that will support adult Chinook salmon migration, egg incubation, smolting, and early-year and late-year juvenile rearing.

Management Goals

- Combine freshwater flows needed to protect species and ecosystem functions in a manner that is comprehensive, does not double count flows, uses an appropriate time step, and is well-documented

- Establish mechanisms to evaluate Delta environmental conditions, periodically review underpinnings of the biological objectives and flow criteria, and change biological objectives and flow criteria when warranted

- Periodically review new research and monitoring to evaluate the need to modify biological objectives and flow criteria

- Do not recommend overly complex flow criteria so as not to infer a greater understanding of specific numeric flow criteria than the available science supports

4.2.2 Selection of Species[10]

Information received during the informational proceeding links the abundance and habitat of several key species that live in, move through, or otherwise depend upon for their survival, the Delta and its ecosystem. DFG Exhibits 1 through 4 present information on the relationship between abundance and the quantity, quality, and timing of flow for the following species: (1) Chinook salmon, (2) Pacific herring, (3) longfin smelt, (4) prickly sculpin, (5) Sacramento splittail, (6) delta smelt, (7) starry flounder, (8) white sturgeon, (9) green sturgeon, (10) Pacific lamprey, (11) river lamprey, (12) bay shrimp, (13) mysid shrimp and a copepod, *Eurytemora affinis*, and (14) American shad. In general, the available data and information indicates:

- For many species, abundance is related to timing and quantity of flow (or the placement of X2).
- For many species, more flow translates into greater species production or abundance.
- Species are adapted to use the water resources of the Delta during all seasons of the year, yet for many species, important life history stages or processes consistently

[10] This section is largely drawn from DFG exhibits 1 through 4.

coincide with the winter-spring seasons and its associated increased flows because this is the reproductive season for most native fishes, and the time that most salmonid fishes are emigrating.

- The source, quantity, quality, and timing of Central Valley tributary outflow affects the same characteristics of mainstem river flow into and through the Delta. Flows in all three of these areas, Delta outflows, tributary inflows, and hydrodynamics, influence production and survival of Chinook salmon in both the San Joaquin River and Sacramento River basins.
- Some invasive species negatively influence native species abundance.

This report is consistent with DFG's recommendation to establish flow criteria for species of priority concern that will benefit most by improving flow conditions. (DFG closing comments, p. 3.) Table 2 (from DFG closing comments p.4) identifies select species that have the greatest ecological, commercial, or recreational importance and are influenced by Delta inflows (including mainstem river tributaries) or Delta outflows. The table identifies the species life stage most affected by flows, the mechanism most affected by flows, and the time when flows are most important to the species.

Table 2. Species of Importance (from DFG closing comments p.4)

Priority Species	Life Stage	Mechanism	Time When Water Flows are Most Important	Reference
Chinook salmon (San Joaquin River basin)	Smolt	Outmigration	March – June	DFG Exhibit 1 – page 2; DFG Exhibit 3 – pages 7-10, 21-35.
Chinook salmon (Sacramento River basin)	Juvenile	Outmigration	November – June	DFG Exhibit 1 – page 1-2, 6-8
Chinook salmon (San Joaquin River tributaries)	Egg/fry	Temperature, DO, upstream barrier avoidance	October – March	DFG Exhibit 3, pages 2-4; DFG Exhibit 4
Longfin smelt	Egg	Freshwater-brackish habitat	December – April	DFG Exhibit 1 – page 2, 9-12
Longfin smelt	Larvae	Freshwater-brackish habitat; transport; turbidity	December – May	DFG Exhibit 1 – page 2, 9-12
Sacramento Splittail	Adults	Floodplain inundating flows	January – April	DFG Exhibit 1 – page 2, 13-14
Sacramento Splittail	Eggs and larvae	Floodplain habitat persistence	January – May	DFG Exhibit 1 – page 3, 13-14

Priority Species	Life Stage	Mechanism	Time When Water Flows are Most Important	Reference
Delta smelt	Larvae and Pre-adult	Transport; habitat	March – November September – November	DFG Exhibit 1 – page 2,14-15
Starry flounder	Settled juvenile; Juvenile-2 yr old	Estuary attraction; habitat	February – May	DFG Exhibit 1 – page 3, 15-16
Bay shrimp	Late-stage larvae and small juveniles	Transport	February – June	DFG Exhibit 1 – page 4; 22-25
Bay shrimp	Juveniles	Nursery habitat	April – June	DFG Exhibit 1 – page 4; 22-25
Mysid shrimp (zooplankton)	All	Habitat	March – November	DFG Exhibit 1 – page 5; 25-26
Eurytemora affinis (zooplankton)	All	Habitat	March – May	DFG Exhibit 1 – page 5; 25-26
American shad	Egg/larvae	Transport; dispersal; habitat	March – June	DFG Exhibit 1 – page 5; 26-28

While many species found in the Delta are of ecological, commercial, and/or recreational interest, specific flow needs for some of those species may not be directly addressed in this report because: they overlap with the needs of more sensitive species otherwise addressed in the report; the relationships between flow and abundance of those species are not well understood; or the needs of those species may be outside the scope of this report. For example, placement of X2 at certain locations in the Delta to protect longfin smelt or starry flounder will also protect striped bass (*Morone saxatilis*). Striped bass survival from egg to 38 mm is significantly increased as X2 shifts downstream in the estuary. (Kimmerer 2002a.) Kimmerer et al. (2009) showed that as X2 location moved downstream, several measures of striped bass survival and abundance significantly increased, as did several measures of striped bass habitat. Similarly, it is assumed that improved stream flow conditions for Chinook salmon will benefit steelhead, but additional work is needed to assure that these flow criteria are adequate for the protection of steelhead. Adult steelhead in the Central Valley migrate upstream beginning in June, peaking in September, and continuing through February or March. (Hallock *et al*. 1961, Bailey 1954, McEwan and Jackson 1996, as cited in SJRRP FMWG 2009.) Spawning occurs primarily from January through March, but may begin as early as December and may extend through April. (Hallock et al. 1961, as cited in McEwan and Jackson 1996.) Steelhead also rear in tributaries to the Delta throughout the year. Consequently, additional inflow criteria may be needed to protect steelhead at times when flows are not specifically recommended to protect Chinook salmon. As will be discussed in the species needs section for Chinook salmon, additional flow criteria may also be needed to protect various runs and life-stages of Chinook salmon. Adequate information is not currently available, however, upon which to base criteria.

Other species are influenced by very high and infrequent flows, far in excess of what could be provided by the State and federal water projects because they occur only during very wet years when project operations are not controlling. For example, white sturgeon are influenced by high winter and spring Delta and river flows (March-June Delta outflow greater than 60,000 cfs) that attract migrating adults, cue spawning, transport larvae, and enhance nursery habitat. These types of flows occur episodically in very wet years. Historical flow patterns combined with the unique life history (long-lived, late maturing, long intervals between spawning, high fecundity) result in infrequent strong recruitment.

There is adequate information in the record, and adequate time to evaluate life history requirements and develop species-specific flow criteria for the following species:

- Chinook Salmon (various runs) (primarily mirgration flows)
- American Shad
- Longfin Smelt
- Delta Smelt
- Sacramento Splittail
- Starry Flounder
- Bay Shrimp
- Zooplankton

4.2.3 Life History Requirements – Anadromous Species

Following are life history and species-specific requirements for Chinook Salmon (including Sacramento River winter-run, Central Valley spring-run, Central Valley fall-run, and Central Valley late fall-run) and American shad.

Chinook Salmon (Sacramento River Winter-Run, Central Valley Spring-Run, Central Valley Fall-Run, and Central Valley Late Fall-Run)

Status

Sacramento River winter-run Chinook salmon is listed as endangered pursuant to the ESA and the CESA. Central Valley spring-run Chinook salmon is listed as threatened pursuant to both the ESA and the CESA. Central Valley fall/late fall-run Chinook salmon are classified as species of special concern pursuant to the ESA.[11]

Life History[12]

Chinook salmon exhibit two generalized freshwater life history types (Healey 1991). Adult "stream-type" Chinook salmon enter freshwater up to several months before spawning, and juveniles reside in freshwater for a year or more, whereas "ocean-type" Chinook salmon spawn soon after entering freshwater and migrate to the ocean as fry or parr within their first year. Adequate instream flows and cool water temperatures are more critical for the survival of Chinook salmon exhibiting a stream-type life history due to over-summering by adults and/or juveniles.

[11] Source: http://www.dfg.ca.gov/fish/Resources/Chinook/index.asp

[12] This section was largely extracted from NMFS 3, pages 76 through 79.

Chinook salmon typically mature between 2 and 6 years of age (Myers et al. 1998). Freshwater entry and spawning timing generally are thought to be related to local water temperature and flow regimes. Runs are designated on the basis of adult migration timing. However, distinct runs also differ in the degree of maturation of the fish at the time of river entry, thermal regime, and flow characteristics of their spawning sites, and the actual time of spawning (Myers et al. 1998). Both winter-run and spring-run tend to enter freshwater as immature fish, migrate far upriver, and delay spawning for weeks or months. Fall-run enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas on the mainstem or lower tributaries of the rivers, and spawn within a few days or weeks of freshwater entry (Healey 1991).

During their upstream migration, adult Chinook salmon require streamflows sufficient to provide olfactory and other orientation cues used to locate their natal streams. Adequate streamflows are necessary to allow adult passage to upstream holding habitat. The preferred temperature range for upstream migration is 38ºF to 56ºF (Bell 1991, DFG 1998). Boles (1988) recommends water temperatures below 65ºF for adult Chinook salmon migration, and Lindley et al. (2004) report that adult migration is blocked when temperatures reach 70ºF, and that fish can become stressed as temperatures approach 70ºF.

Information on the migration rates of adult Chinook salmon in freshwater is scant and primarily comes from the Columbia River basin (Matter and Sanford 2003). Keefer et al. (2004) found migration rates of Chinook salmon ranging from approximately 10 kilometers (km) per day to greater than 35 km per day and to be primarily correlated with date, and secondarily with discharge, year, and reach, in the Columbia River basin. Matter and Sanford (2003) documented migration rates of adult Chinook salmon ranging from 29 to 32 km per day in the Snake River.

Adult Chinook salmon inserted with sonic tags and tracked throughout the Delta and lower Sacramento and San Joaquin rivers were observed exhibiting substantial upstream and downstream movement in a random fashion, for several days at a time, while migrating upstream (CALFED 2001). Adult salmonids migrating upstream are assumed to make greater use of pool and mid-channel habitat than channel margins (Stillwater Sciences 2004), particularly larger salmon such as Chinook salmon, as described by Hughes (2004). During their upstream migration, adults are thought to be primarily active during twilight hours.

Spawning Chinook salmon require clean, loose gravel in swift, relatively shallow riffles or along the margins of deeper runs, and suitable water temperatures, depths, and velocities for redd construction and adequate oxygenation of incubating eggs. Chinook salmon spawning typically occurs in gravel beds that are located at the tails of holding pools (USFWS 1995). The range of water depths and velocities in spawning beds that Chinook salmon find acceptable is very broad. The upper preferred water temperature for spawning Chinook salmon is 55ºF to 57ºF (Chambers 1956, Smith 1973, Bjornn and Reiser 1991, and Snider 2001).

Incubating eggs are vulnerable to adverse effects from floods, siltation, desiccation, disease, predation, poor gravel percolation, and poor water quality. Studies of Chinook salmon egg survival to hatching conducted by Shelton (1995) indicated 87% of fry emerged successfully from large gravel with adequate subgravel flow. The optimal water temperature for egg incubation ranges from 41ºF to 56ºF [44ºF to 54ºF (Rich 1997), 46ºF to 56ºF (NMFS 1997), and 41ºF to 55.4ºF (Moyle 2002)]. A significant reduction in egg viability occurs at water temperatures above 57.5ºF and total embryo mortality can occur at temperatures above 62ºF (NMFS 1997). Alderdice and Velsen (1978) found that the upper and lower temperatures resulting in 50% pre-hatch mortality were 61ºF and 37ºF, respectively, when the incubation

temperature was held constant. As water temperatures increase, the rate of embryo malformations also increases, as well as the susceptibility to fungus and bacterial infestations. The length of development for Chinook salmon embryos is dependent on the ambient water temperature surrounding the egg pocket in the redd. Colder water necessitates longer development times as metabolic processes are slowed. Within the appropriate water temperature range for embryo incubation, embryos hatch in 40 to 60 days, and the yolk-sac fry remain in the gravel for an additional 4 to 6 weeks before emerging from the gravel.

During the 4 to 6 week period when alevins remain in the gravel, they utilize their yolk-sac to nourish their bodies. As their yolk-sac is depleted, fry begin to emerge from the gravel to begin exogenous feeding in their natal stream. Fry typically range from 25 mm to 40 mm at this stage. Upon emergence, fry swim or are displaced downstream (Healey 1991). The post-emergent fry disperse to the margins of their natal stream, seeking out shallow waters with slower currents, finer sediments, and bank cover such as overhanging and submerged vegetation, root wads, and fallen woody debris, and begin feeding on zooplankton, small insects, and other microcrustaceans. Some fry may take up residence in their natal stream for several weeks to a year or more, while others are displaced downstream by the stream's current. Once started downstream, fry may continue downstream to the estuary and rear there, or may take up residence in river reaches farther downstream for a period of time ranging from weeks to a year (Healey 1991).

Fry then seek nearshore habitats containing riparian vegetation and associated substrates important for providing aquatic and terrestrial invertebrates, predator avoidance, and slower velocities for resting (NMFS 1996). The benefits of shallow water habitats for salmonid rearing have been found to be more productive than the main river channels, supporting higher growth rates, partially due to higher prey consumption rates, as well as favorable environmental temperatures (Sommer et al. 2001).

When juvenile Chinook salmon reach a length of 50 to 57 mm, they move into deeper water with higher current velocities, but still seek shelter and velocity refugia to minimize energy expenditures (Healey 1991). Catches of juvenile salmon in the Sacramento River near West Sacramento exhibited larger-sized juveniles captured in the main channel and smaller-sized fry along the margins (USFWS 1997). When the channel of the river is greater than 9 to 10 feet in depth, juvenile salmon tend to inhabit the surface waters (Healey 1982). Migrational cues, such as increasing turbidity from runoff, increased flows, changes in day length, or intraspecific competition from other fish in their natal streams, may spur outmigration of juveniles from the upper Sacramento River basin when they have reached the appropriate stage of maturation (Kjelson et al. 1982, Brandes and McLain 2001).

As fish begin their emigration, they are displaced by the river's current downstream of their natal reaches. Similar to adult movement, juvenile salmonid downstream movement is crepuscular. Juvenile Chinook salmon migration rates vary considerably presumably depending on the physiological stage of the juvenile and hydrologic conditions. Kjelson *et al*. (1982) found Chinook salmon fry to travel as fast as 30 km per day in the Sacramento River, and Sommer et *al.* (2001) found travel rates ranging from approximately 0.5 miles up to more than 6 miles per day in the Yolo Bypass. As Chinook salmon begin the smoltification stage, they prefer to rear further downstream where ambient salinity is up to 1.5 to 2.5 parts per thousand (ppt, Healey 1980, Levy and Northcote 1981).

Fry and parr may rear within riverine or estuarine habitats of the Sacramento River, the Delta, and their tributaries (Maslin et al. 1997, Snider 2001). Within the Delta, juvenile Chinook

salmon forage in shallow areas with protective cover, such as intertidal and subtidal mudflats, marshes, channels, and sloughs (McDonald 1960, Dunford 1975, Meyer 1979, Healey 1980). Cladocerans, copepods, amphipods, and larvae of diptera, as well as small arachnids and ants are common prey items (Kjelson et al. 1982, Sommer et al. 2001, MacFarlane and Norton 2002). Shallow water habitats are more productive than the main river channels, supporting higher growth rates, partially due to higher prey consumption rates, as well as favorable environmental temperatures (Sommer et al. 2001). Optimal water temperatures for the growth of juvenile Chinook salmon in the Delta are between 54ºF to 57ºF (Brett 1952). In Suisun and San Pablo bays, water temperatures reach 54ºF by February in a typical year. Other portions of the Delta (*i.e*., South Delta and Central Delta) can reach 70ºF by February in a dry year. However, cooler temperatures are usually the norm until after the spring runoff has ended.

Within the estuarine habitat, juvenile Chinook salmon movements are dictated by the tidal cycles, following the rising tide into shallow water habitats from the deeper main channels, and returning to the main channels when the tide recedes (Levings 1982, Levy and Northcote 1982, Levings et al. 1986, Healey 1991). As juvenile Chinook salmon increase in length, they tend to school in the surface waters of the main and secondary channels and sloughs, following the tides into shallow water habitats to feed (Allen and Hassler 1986). In Suisun Marsh, Moyle et al. (1989) reported that Chinook salmon fry tend to remain close to the banks and vegetation, near protective cover, and in dead-end tidal channels. Kjelson et al. (1982) reported that juvenile Chinook salmon demonstrated a diel migration pattern, orienting themselves to nearshore cover and structure during the day, but moving into more open, offshore waters at night. The fish also distributed themselves vertically in relation to ambient light. During the night, juveniles were distributed randomly in the water column, but would school up during the day into the upper 3 meters of the water column. Available data indicate that juvenile Chinook salmon use Suisun Marsh extensively both as a migratory pathway and rearing area as they move downstream to the Pacific Ocean. Juvenile Chinook salmon were found to spend about 40 days migrating through the Delta to the mouth of San Francisco Bay and grew little in length or weight until they reached the Gulf of the Farallones (MacFarlane and Norton 2002). Based on the mainly oceantype life history observed (*i.e.*, fall-run), MacFarlane and Norton (2002) concluded that unlike other salmonid populations in the Pacific Northwest, Central Valley Chinook salmon show little estuarine dependence and may benefit from expedited ocean entry.

Population Distribution and Abundance

Four seasonal runs of Chinook salmon occur in the Central Valley, with each run defined by a combination of adult migration timing, spawning period, and juvenile residency and smolt migration periods. (Fisher 1994 as cited in Yoshiyama et al. 2001 p. 73.) The runs are named after the season when adults move upstream to migrate-- winter, spring, fall, and late-fall. The Sacramento River basin supports all four runs resulting in adult salmon being present in the basin throughout the year. (Stone 1883a; Rutter 1904; Healey 1991; Vogel and Marine 1991 as cited in Yoshiyama *et. al,* 2001 p. 73.) Historically, different runs occurred in the same streams staggered in time to correspond to the appropriate stream flow regime for which that species evolved, but overlapping. (Vogel and Marine 1991; Fisher 1994 as cited in Yoshiyama et al*.,* 2001, p. 73.) Typically, fall and late-fall runs spawn soon after entering natal streams and spring and winter runs typically "hold" for up to several months before spawning. (Rutter 1904; Reynolds and others 1993 as cited in Yoshiyama *et. al,* 2001, p. 73.) These runs and their life-cycle timing are summarized in Table 3 and described in more detail below.

Winter-Run - Due to a need for cool summer flows, Sacramento River winter-run originally likely only spawned in the upper Sacramento River tributaries, including the McCloud, Pit, Fall, and Little Sacramento rivers and Battle Creek. (NMFS 5, p. 16.) As a result of construction of

Shasta and Keswick Dams, today all spawning habitat above Keswick Dam has been eliminated and approximately 47 of the 53 miles of habitat in Battle Creek has been eliminated. (Yoshiyama et al. 1996, as cited in NMFS 5, p. 16.) Currently, winter-run habitat is likely limited to the Sacramento River reach between Keswick Dam downstream of the Red Bluff Diversion Dam. (NMFS 5, p. 16.)

The winter-run population is currently very vulnerable due to its low population numbers and the fact that only one population exists. (Good et al. 2005, as cited in NMFS 5, p. 16.) In the late 1960s escapement was near 100,000 fish declining to fewer than 200 fish in the 1990s. (*Id*.) Recent escapement estimates from 2004 to 2006 averaged 13,700 fish. (DFG Website 2007, as cited in NMFS 5, p. 16.) However, in 2007 and 2008 escapements were less than 3,000 fish. Since 1998, hatchery produced winter-run have been released likely contributing to the observed increased escapement numbers. (Brown and Nichols 2003 as cited in NNFS 5, p. 16.) In addition, a temperature control device was installed on Shasta Dam in 1997 likely improving conditions for winter-run. (NMFS 5, p. 18.)

Spring-Run - Historically, spring-run were likely the most abundant salmonid in the Central Valley inhabiting headwater reaches of all major river systems in the Central Valley in the absence of natural migration barriers. (NMFS 5, p. 28.) Since the 1880s, construction of dams and other factors have significantly reduced the numbers and range of spring-run in the Central Valley. (*Id*.) Currently, the only viable populations occur on Mill, Deer, and Butte creeks, but those populations are small and isolated. (DFG 1998, as cited in NMFS 5, p. 28.) In addition, the Feather River Fish Hatchery which opened in 1967 produces spring-run salmon. However, significant hybridization of these hatchery fish with fall-run has occurred. (NMFS 5, p. 28-31.)

Historically, Central Valley spring-run numbers were estimated to be as large as 600,000 fish. (DFG 1998 as cited in NMFS 5, p. 28.) Nearly 50,000 spring-run adults were counted on the San Joaquin River prior to construction of Friant Dam. (Fry 1961 as cited in NMFS 5, p. 28.) Shortly after construction of Friant Dam, spring-run were extirpated on the San Joaquin River. (Yoshiyama et al. 1998 as cited in NMFS 5, p. 28.) Since 1970, estimates of spring-run populations in the Sacramento River have been as high as 30,000 fish and as low as 3,000 fish. (NMFS 5, p. 28.)

Fall-Run - Historically, fall run likely occurred in all Central Valley streams that had adequate flows during the fall months, even if the streams were intermittent during other parts of the year. (Yoshiyama *et. al* 2001, p. 74.) Due to their egg-laden and deteriorating physical condition, fall-run likely historically spawned in the valley floor and lower foothill reaches and probably were limited in their upstream migration. (Rutter 1904 as cited in Yoshiyama *et. al* 2001, p. 74.)

Currently, fall-run Chinook inhabit both the Sacramento and San Joaquin river basins and are currently the most abundant of the Central Valley races, contributing to large commercial and recreational fisheries in the ocean and popular sportfisheries in the freshwater streams. Fall-run Chinook are raised at five major Central Valley hatcheries which release more than 32 million smolts each year. In the past few years, there have been large declines in fall-run populations with escapements of 88,0000 and 66,000 fish in 2007 and 2008. (NMFS 2009, p. 4.) NMFS concluded that the recent declines were likely primarily due to poor ocean conditions in 2005 and 2006. (*Id*.) Other factors contributing to the decline of fall-run include: loss of spawning grounds due to dams and other factors, degradation of spawning habitat from water diversions, introduced species, altered sediment dynamics, hatchery practices, degraded water quality, and loss of riparian and estuarine habitat. (*Id*.)

Late-Fall Run - Historically, late fall-run probably spawned in the mainstem Sacramento River and major tributary reaches and possibly in the San Joaquin River upstream of its tributaries. (Hatton and Clark 1942; Van Cleve 1945; Fisher 1994 as cited in Yoshiyama *et. al* 2001.) Today, late-fall run are mostly found in the upper Sacramento River where the river remains deep and cool enough in the summer for juvenile rearing. (Moyle 2002, p. 254.) The late fall-run has continued low, but potentially stable abundance. (NMFS 2009, p. 4.) Estimates from 1992 ranged from 6,700 to 9,700 fish and in 1998 were 9,717 fish. However, changes in estimation methods, lack of data, and hatchery influences make it difficult to accurately estimate abundance trends for this run. (*Id*.)

Table 3. Generalized Life History Timing of Central Valley Chinook Salmon Runs

	Migration Period	**Peak Migration**	**Spawning Period**	**Peak Spawning**	**Juvenile Emergence Period**	**Juvenile Stream Residency**
Sacramento River Basin Late Fall-Run	October–April	December	Early January–April	February–March	April-June	7-13 months
Winter-Run	December-July	March	Late April-early August	May-June	July-October	5-10 months
Spring-Run	March-September	May- June	Late August-October	Mid-September	November-March	3-15 months
Fall Run	June-December	September-October	Late September-December	October-November	December-March	1-7 months
San Joaquin (Tuolumne River) Fall-Run	October-early January	November	Late October-January	November	December-April	1-5 months

Source: Yoshiyama *et al*. (1998) as cited in Moyle 2002, p. 255.

Population Abundance and Relationship to Flow

Delta outflows and inflows affect rearing conditions and migration patterns for Chinook salmon in the Delta watershed. Freshwater flow serves as an important cue for upstream adult migration and directly affects juvenile survival and abundance as they move downstream through the Delta. (DOI 1, p. 23.) Decreased flows may decrease migration rates and increase exposure to unsuitable water quality and temperature conditions, predators, and entrainment at water diversion facilities. (DFG 1, p. 1.) For the most part, relationships between salmon survival and abundance have been developed using tributary inflows rather than Delta outflows, however, the Delta is an extension of the riverine environment until salmon reach the salt water interface. (DOI 1, p. 29.) Prior to development and channelization, the Delta provided hospitable habitat for salmon. With channelization and other development, the environment is no longer hospitable for salmon. As a result, the most beneficial Delta outflow pattern for salmon may currently be one that moves salmon through the Delta faster. (*d*.)

Salmon respond behaviorally to variations in flows. Monitoring shows that juvenile and adult salmon begin migrating during the rising limb of the hydrograph. (DOI 1, p. 30.) For juveniles, pulse flows appear to be more important than for adults. (*Id*.) For adults, continuous flows through the Delta and up to each of the natal tributaries appears to be more important. (*Id*.) Flows and water temperatures are also important to maintain populations with varied life history strategies in different year types to insure continuation of the species over different hydrologic

and other conditions. For salmon migrating as fry within a few days of emigration from redds, increased flows provide improved transport downstream and improved rearing habitat, and for salmon that stay in the rivers to rear, increased flows provide for increased habitat and food production. (DOI 1, 30.)

Population Abundance Goal

The immediate goal is to significantly improve survival of all existing runs of Chinook salmon that migrate through the Delta in order to facilitate positive population growth in the short term and subsequently achieve the narrative salmon protection objective identified in the 2006 Bay-Delta Plan to double the natural production of Chinook salmon from the average production from 1967 to 1991 consistent with the provisions of State and federal law. (State Water Board 2006a, p. 14.)

Species- Specific Recommendations

Delta Outflow

No specific Delta outflow criteria are recommended for Chinook salmon. Any flow needs would generally be met by the following inflow criteria and by the Delta outflow criteria determined for estuarine dependant species discussed elsewhere in this report.

Sacramento River Inflows

The 2006 Bay-Delta Plan includes flow objectives for the Sacramento River at Rio Vista for the protection of fish and wildlife beneficial uses from September through December ranging from 3,000 to 4,500 cfs. (State Water Board 2006a, p. 15.) These flow objectives are in part intended to provide attraction and transport flows and suitable habitat conditions for Chinook salmon. (State Water Board 2006b, p. 49.) The 2006 Bay-Delta Plan includes Delta outflow objectives for the remainder of the year, which effectively provide Sacramento River inflows. However, the Bay-Delta Plan does not include any specific Sacramento River flow requirements for the remainder of the year, including the critical spring period.

Habitat alterations in the Delta limit Sacramento River salmon production primarily through reduced survival during the outmigrant (smolt) stage. Decreases in flow through the estuary, increased temperatures, and the proportion of flow diverted through the Delta Cross Channel and Georgiana Slough on the Sacramento River are associated with lower survival in the Delta of marked juvenile fall-run Sacramento River salmon. (DOI 1, p. 24.) In 1981 (p. 17-18) and 1982 (p. 404), Kjelson et al. reported that flow was positively correlated with juvenile fall-run Chinook salmon survival through the Delta and that temperature was negatively correlated with survival. In testimony before the State Water Board in 1987 Kjelson presented additional analyses that again showed that survival of fall-run Chinook salmon smolts through the Delta between Sacramento and Suisun Bay was found to be positively correlated to flow and negatively correlated to water temperature. (p. 36.) Smolt survival increased with increasing Sacramento River flow at Rio Vista, with maximum survival observed at or above about 20,000 and 30,000 cfs from April through June (p. 36), while no apparent relationship was found at flows between 7,000 and 19,000 cfs (p. 27), suggesting a potential threshold response to flow. Smolt survival was also found to be highest when water temperatures were below 66ºF. (p. 61.) In addition to increased survival, juvenile abundance has also been found to be higher with greater Sacramento River flow. (DFG 3, pp. 1 and 6.) The abundance of juvenile Chinook salmon leaving the Delta at Chipps Island was found to be highest when Rio Vista flows averaged above 20,000 cfs from April through June. (*Id.*)

Dettman et al. (1987) reanalyzed data from the 1987 Kjelson experiments and found a positive correlation between an index of spawning returns, based on coded-wire tagged fish, and both

June and July outflow from the Delta. (p. 1.) In 1989, Kjelson and Brandes updated and confirmed Kjelson's 1987 findings again reporting that survival of smolts through the Delta from Sacramento to Suisun Bay was highly correlated to mean daily Sacramento River flow at Rio Vista. (p. 113.) In the State Water Board's 1992 hearings, USFWS (1992) presented additional evidence, based on data collected from 1988 to 1991, that increased flow in the Delta may increase migration rates of both wild and hatchery fish migrating from the North Delta (Sacramento and Courtland) to Chipps Island. (DOI 1, p. 26.)

In 2001, Brandes and McLain confirmed the relationships between water temperature, flow, and juvenile salmonid survival. (p. 95.) In 2006, Brandes et al. updated findings regarding the relationship between Sacramento River flows and survival and found that the catch of Chinook salmon smolts surveyed at Chipps Island between April and June of 1978 to 2005 was positively correlated with mean daily Sacramento River flow at Rio Vista between April and June. (p. 41-46.)

In addition to the flow versus juvenile fall-run Chinook salmon survival relationships discussed above, several studies show that loss of migrating salmonids within Georgiana Slough and the interior Delta is approximately twice that of fish remaining in the mainstem Sacramento River. (Kjelson and Brandes 1989; Brandes and McLain 2001; Vogel 2004, 2008; and Newman 2008 as cited in NMFS 3, p. 640). Recent studies and modeling efforts have found that increasing Sacramento River flow such that tidal reversal does not occur in the vicinity of Georgiana Slough and at the Cross Channel Gates would lessen the proportion of fish diverted into channels off the mainstem Sacramento River. (Perry et al. 2008, 2009.) Thus, closing the Delta Cross Channel and increasing the flow on the Sacramento River to levels where there is no upstream flow from the Sacramento River entering Georgiana Slough on the flood tide during the juvenile salmon migration period (November to June) will likely reduce the number of fish that enter the interior Delta and improve survival. (DOI 1, p. 24.) To achieve no bidirectional flow in the mainstem Sacramento River near Georgiana Slough, flow levels of 13,000 (personal communication Del Rosario) to 17,000 cfs at Freeport are needed. (DOI 1, p. 24.)

Monitoring of emigration of juvenile Chinook salmon on the lower Sacramento River near Knights Landing also indicates a relationship between timing and magnitude of flow in the Sacramento River and the migration timing and survival of Chinook salmon approaching the Delta from the upper Sacramento River basin. (Snider and Titus 1998, 2000a, 2000b, 2000c, and subsequent draft reports and data as cited in DFG 1, p. 7.) The emigration timing of juvenile late fall, winter, and spring-run Chinook salmon from the upper Sacramento River basin depends on increases in river flow through the lower Sacramento River in fall, with significant precipitation in the basin by November to sustain downstream migration of juvenile Chinook salmon approaching the Delta. (Titus 2004 as cited in DFG 1, p. 7.) Sacramento River flows at Wilkins Slough of 15,000 to 20,000 cfs following major precipitation events are associated with increased emigration. (DFG 1, p. 7 and NMFS 7, p. 2-4.)

Delays in precipitation producing flows result in delayed emigration which may result in increased susceptibility to in-river mortality from predation and poor water quality conditions. (DFG 1, p. 7.) Allen and Titus (2004) suggest that the longer the delay in migration, the lower the survival of juvenile salmon to the Delta. (as cited in DFG 1, p. 7.) DFG indicates that juvenile Chinook salmon appear to need increases in Sacramento River flow that correspond to flows in excess of 20,000 cfs at Wilkins Slough by November with similar peaks continuing past the first of the year. (DFG 1, p. 7.) Pulse flows in excess of 15,000 to 20,000 cfs may also be necessary to erode sediment in the upper Sacramento River downstream of Shasta to create turbid inflow pulses to the Delta. (AR/NHI 1, p. 32.)

Salmon are the only species considered for the Sacramento River inflow criteria; discussion of the flow criteria for Sacramento River inflows is therefore continued in Section 5.2, Sacramento River Inflow criteria.

San Joaquin River Inflows

Currently the Merced, Tuolumne, and Stanislaus river tributaries to the San Joaquin River support fall-run Chinook salmon. Historically spring-run also inhabited the basin. Pursuant to the San Joaquin River Restoration effort, there are plans to reintroduce spring-run Chinook salmon to the main-stem river beginning in 2012. Since the 1980s (1980-1989), San Joaquin basin fall-run Chinook salmon escapement numbers have declined from approximately 26,000 fish to 13,000 fish in the 2000s (2000-2008). (TBI/NRDC 3, p. 22.) Flow related conditions are believed to be a significant cause of this decline.

The 2006 Bay-Delta Plan includes flow objectives for the San Joaquin River at Vernalis, largely for the protection of fall-run Chinook salmon. The plan includes base flows during the spring (February through June with the exception of mid-April through mid-May) that vary between 700 and 3,420 cfs based on water year type and required location of X2. To improve juvenile fall-run Chinook salmon outmigration, the Plan also includes spring pulse flows (mid-April through mid-May) that vary between 3,110 and 8,620 cfs, however, those flows have never been implemented and have instead been replaced with the Vernalis Adaptive Management Plan (VAMP) flow targets for the past 10 years. The VAMP flows are lower than the pulse flow objectives and vary between 2,000 and 7,000 cfs based on existing flows and other conditions. (State Water Board 2006a, p. 24-26.) The 2006 Bay-Delta Plan also includes a flow objective of 1,000 to 2,000 cfs during October to support adult fall-run Chinook salmon migration. (State Water Board 2006b, p. 15-16.) The 2006 Bay-Delta Plan does not include any specific flow requirements during the remainder of the year. (State Water Board 2006b, pg. 50.)

Inflows from the San Joaquin River affect various life stages of Chinook salmon including adult migration, spawning, egg incubation, juvenile rearing, and juvenile emigration to the ocean. Evidence indicates that to maintain a viable Chinook salmon population, escapements should not decline below approximately 833 adult salmon per year (a total of 2,500 salmon in 3 years), and fluctuations in escapement between wet and dry years should be reduced by increasing dry year escapements and the percentages of hatchery fish should be reduced to no more than 10%. (Lindley and others 2007, as cited in CSPA 14, p. 3-4.) Mesick estimates that the Tuolumne River population is currently at a high risk of extinction (Mesick 2009); and that the Stanislaus and Merced river populations are also likely soon to be at a high risk of extinction due to high percentages of hatchery fish. (CSPA 7, p.4.)

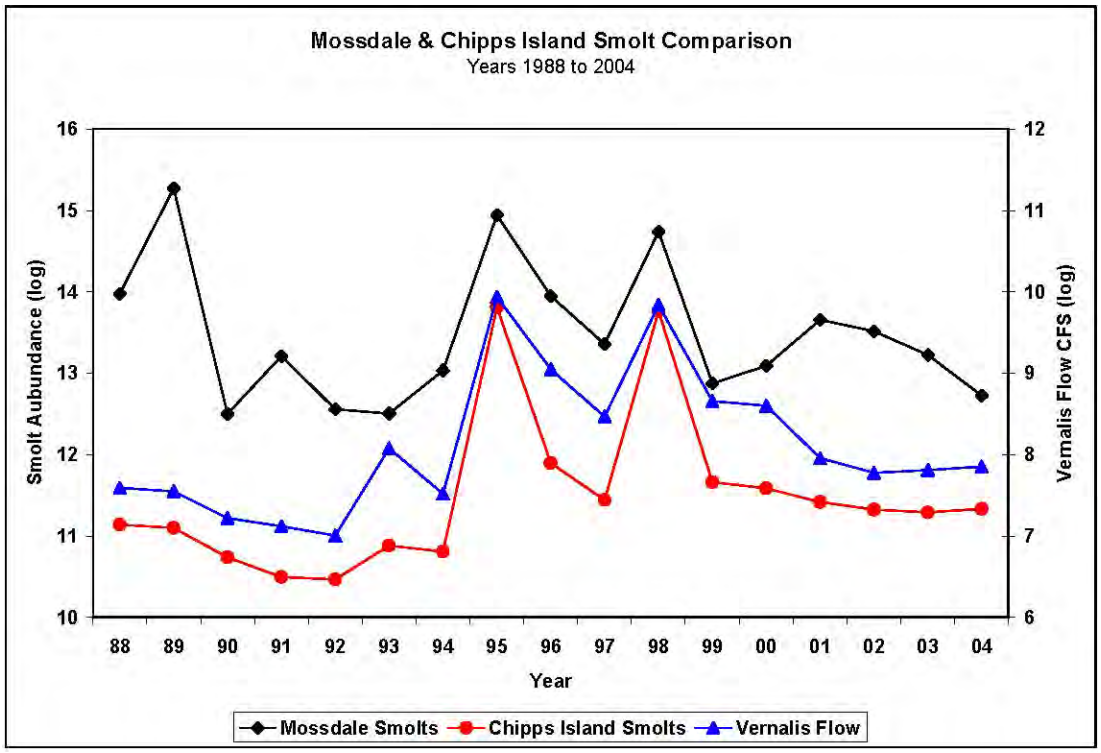
Mesick estimates that the decline in escapement on the Tuolumne River from 130,000 salmon in the 1940s to less than 500 in recent years is primarily due to inadequate minimum instream flow releases from La Grange Dam in late winter and spring during non-flood years. (CSPA 14, p. 1.) Mesick suggests that escapement has been primarily determined by the rate of juvenile survival, which is primarily determined by the magnitude and duration of late winter and spring flows since the 1940s. (CSPA 14, p. 2.) Mesick indicates that other analyses show that spawner abundance, spawning habitat degradation, and the harvest of adult salmon in the ocean have not caused the decline in escapement. (CSPA 14, p. 1.)

Successful adult Chinook salmon migration depends on environmental conditions that cue the response to return to natal streams. Optimal conditions help to reduce straying and maintain egg viability and fecundity rates. (DFG 3, p. 2 and CSPA 7, p. 1.) Analyses of flow needs for

the protection of adult fall-run migration conducted by Hallock and others from 1964 to 1967 indicate that the presence of Sacramento River water in the central and south Delta channels results in migration delays for both San Joaquin River and Sacramento River basin salmon. (Hallock et al., 1970 as cited in DOI 1, p. 25.) These analyses also show that reverse flows on the San Joaquin River delay and potentially hamper migration. (*Id.*) In addition, analyses by Hallock show that water temperatures in excess of 65° F and low DO conditions of less than 5 mg/l in the San Joaquin River near Stockton act as a barrier to adult migration. (as cited in AFRP 2005, p. 11.) Delayed migration may result in reduced gamete viability under elevated temperatures and mortality to adults prior to spawning. (AFRP 2005, p. 12.)

Mesick found that up to 58% of Merced River Hatchery Chinook salmon strayed to the Sacramento River Basin when flows in the San Joaquin River were less than 3,500 cfs for ten days in late October, but stray rates were less than 6% when flows were at least 3,500 cfs. (CSPA 14, p. 15 and CSPA 7, p. 1.) Mesick indicates that providing 1,200 cfs flows from the tributaries to the San Joaquin River (Merced, Tuolumne, and Stanislaus) for ten days in late October increases escapement by an average of 10%. (Mesick 2009 as cited in CSPA 7, p. 1.) The 2005 AFRP includes similar recommendations for flows of 1,000 cfs from each of the San Joaquin River tributaries. (AFRP, p. 12.) Such flows would likely improve DO conditions, temperatures, and olfactory homing fidelity for San Joaquin basin salmon. (Harden Jones 1968, Quinn et al. 1989, Quinn 1990 as cited in EDF 1, p. 48.) To achieve olfactory homing fidelity and continuous flows for adult migration, the physical source of this water is at least as important as the volume or rate of flow, especially given that the entire volume of the San Joaquin River during the fall period is typically diverted at the southern Delta export facilities. (EDF 1. p. 48.) Even in the absence of exports, it is necessary for the scent of the San Joaquin basin watershed to enter the Bay in order for adult salmonids to find their way back to their natal rivers. (NMFS 2009, p.407 as cited in EDF 1, p. 48.)

Outmigration success of juvenile Chinook salmon is affected by multiple factors, including water diversions and conditions related to flow. Data show that smolt survival and resulting adult production is better in wet years. (Kjelson and Brandes, 1989, SJRGA, 2007 as cited in DOI 1, p. 24.) VAMP analyses indicate that San Joaquin River flow at Vernalis is positively associated with the probability of survival for outmigrating smolts from Dos Reis (downstream of the Old River bifurcation) to the Delta (Jersey Point). (Newman, 2008 as cited in DOI 1, p. 24.) A positive relationship has also been shown between salmon survival indices and flow at Jersey Point for fish released at Jersey Point. (USFWS 1992, p. 21 as cited in DOI 1, p. 24.) Data indicate that maximum San Joaquin basin adult fall-run chinook salmon escapement may be achieved with flows exceeding 20,000 cfs at Vernalis during the smolt emigration period of April 15 through June 15. (2006 VAMP report page 65; DOI 1, p. 25.) As indicated below in Figure 9, DFG found that more spring flow from the San Joaquin River tributaries results in more juvenile salmon leaving the tributaries, more salmon successfully migrating to the South Delta, and more juvenile salmon surviving through the Delta. (DFG 3, p. 17.) DFG concludes that the primary mechanism needed to substantially produce more smolts at Jersey Point is to substantially increase the spring Vernalis flow level (magnitude, duration, and frequency) which will produce more smolts leaving the San Joaquin River tributaries, and produce more smolts surviving to, and through, the South Delta. (DFG 3, p. 17-18.) DFG indicates that random rare and unpredictable poor ocean conditions may cause stochastic high mortality of juvenile salmon entering the ocean, but that the overwhelming evidence is that more spring flow results in higher smolt abundance, and higher smolt abundance equates to higher adult production. (DFG 3, p.17.)



Note: This figure shows the relationship of smolt abundance (log transformed) at Mossdale to estimate smolt abundance at Chipps Island by average spring (3/15 to 6/15) Vernalis flow level (log transformed). To estimate the number of smolts at Chipps Island the smolt survival vs. flow level relationship developed by Dr. Hubbard was applied on a daily basis to the Mossdale smolt abundance and out-migration pattern. Smolt abundance at Chipps Island (or stated differently smolt survival through the Delta on an annual basis) can change by an order of magnitude pending Vernalis flow rate. (DFG 3, p. 16.)

Figure 9. Salmon Smolt Survival and San Joaquin River Vernalis Flows

Elevated flows during the smolt outmigration period function as an environmental cue to trigger migration, facilitate transport of juveniles downstream, improve migration corridor conditions to inundate floodplains, reduce predation and improve temperature and other water quality conditions; these are all functions that are currently extremely impaired on the San Joaquin River. (e.g., "Steelhead stressor matrix," NMFS 2009 as cited in TBI/NRDC 3, p. 7.) Under the 2006 Bay-Delta Plan, elevated flows are limited to approximately the mid-April to mid-May period. However, outmigration timing in the San Joaquin River basin occurs over a prolonged time frame from mid-March through June. (TBI/NRDC 3, p. 12-13.) This restricted window may impair population viability by limiting survival of fish that migrate outside of this time period, thus reducing the life history diversity and the genetic diversity of the population. (TBI/NRDC 3, p. 11-12.) Diverse migration timing increases population viability by making it more likely that at least some portion of the population is exposed to favorable ecological conditions in the Delta and into the ocean. (Smith et al. 1995 as cited in TBI/NRDC 3, p. 12.)

Temperature conditions in the San Joaquin River basin may limit smolt outmigration and survival. Lethal temperature thresholds for Pacific salmon depend, to some extent, on acclimation temperatures. (Myrick and Cech 2004 as cited in TBI/NRDC 3, p. 18.) Central Valley salmonids are generally temperature-stressed through at least some portion of their freshwater life-cycle. (e.g. Myrick and Cech 2004, 2005 as cited in TBI/NRDC 3, p. 18.) Lethal temperature effects commence in a range between 71.6˚ and 75.2˚ F (Baker et al.1995 as cited

in TBI/NRDC 3, p. 18), with sub-lethal effects occurring at lower temperatures. Access to food also affects temperature responses. When fish have adequate access to food, growth increases with increasing temperature, but when food is limited (which is typical), optimal growth occurs at lower temperatures. (TBI/NRDC 3, p 18.) Marine and Cech (2004) observed decreased growth, smoltification success, and predator avoidance at temperatures above 68˚ F and that fish reared at temperatures between 62.6˚ and 68˚ F experienced increased predation compared to fish reared at between 55.4˚ and 60.8˚ F. (as cited in TBI/NRDC 3, p. 18.) Several studies indicate that optimal rearing temperatures for Chinook salmon range from 53.6˚ to 62.6F (Richter and Kolmes 2005 as cited in TBI/NRDC 3, p. 18.) Mesick found that Tuolumne River smolt outmigration rates and adult recruitment were highest when water temperatures were at or below 59˚F when smolts were migrating in the lower river. (Mesick 2009, p. 25.) Elevated temperatures may also affect competition between different species. (Reese and Harvey 2002 as cited in TBI/NRDC 3, p. 18.)

Temperature is determined by a number of factors including reservoir releases, channel geometry, and ambient air temperatures. As a result, a given flow may achieve different water temperatures depending on the other conditions listed above. Cain estimates that flows over 5,000 cfs in late spring (April to May) generally provide water temperatures (below 65˚ F) suitable for Chinook salmon, but that flows less than 5,000 cfs may be adequate to provide sufficient temperature conditions. (Cain 2003 as cited in TBI/NRDC 3, p 13-14.) Mesick indicates that salmon smolt survival can be improved by maintaining water temperatures near 59˚F from March 15 to May 15 and as low as practical from May 16 to June 15. (CSPA 7, p. 2-3.) To maintain mean water temperatures near 59˚F and maximum temperatures below 65˚F from March 15 to May 15 in the tributaries downstream to the confluence with the San Joaquin River, Mesick indicates that flows need to be increased in response to average air temperature. (CSPA 7, p. 3.)

There are several different estimates for flow needs on the San Joaquin River during the spring period to improve or double salmon populations on the San Joaquin River. The USFWS's 2005 *Recommended Streamflow Schedules to Meet the AFRP Doubling Goal in the San Joaquin River Basin* (2005 AFRP) concludes that the declines in salmon in the San Joaquin River basin primarily resulted from reductions in the frequency and magnitude of spring flooding in the basin from 1992-2004 compared to the baseline period of 1967-1991. (2005 AFRP, p. 1.) The AFRP states that the most likely method to increase production of fall-run Chinook salmon is to increase flows from February to March to increase survival of juveniles in the tributaries and smolts in the mainstem and then to increase flows from April to mid-June to increase smolt survival through the Delta. (*Id*.) Using salmon production models for the San Joaquin River Basin, the AFRP provides recommendations for the amount of flow at Vernalis that would be needed to double salmon production in the San Joaquin River basin. On average, over the four month period of February to May, the AFRP recommends that flows range from less than 4,000 cfs in critical years to a little more than 10,000 cfs in wet years. From March through June, AFRP recommends that flows average between about 4,500 cfs in critical years to more than 12,000 cfs in wet years. (2005 AFRP, p. 8-10.)

Using a non-linear regression empirical data driven fall-run Chinook salmon production model, DFG developed flow recommendations for the San Joaquin River from March 15 through June 15 to double Chinook salmon smolt production. DFG developed a variety of modeling scenarios to evaluate the effects of various combinations of flow magnitudes and durations in order to identify the combination of flow levels varied by water year type to achieve doubling of juveniles. Base flows for the March 15 through June 15 period vary between 1,500 cfs in critical years to

6,315 cfs in wet years. Pulse flow recommendations vary between 7,000 cfs and 15,000 cfs for durations of 31 to 70 days depending on water year type. (DFG 3, p. 34.)

In analyzing the relationship between Vernalis flow and cohort return ratios of San Joaquin River Chinook salmon, TBI/NRDC found that Vernalis average March through June flows of approximately 4,600 cfs corresponded to an equal probability for positive population growth or negative population growth. (TBI/NRDC 3, p. 24.) TBI/NRDC found that average March through June flows exceeding 5,000 cfs resulted in positive population growth in 84% of years with only 66% growth in years with flows less than 5,000 cfs. (*Id.)* TBI/NRDC found that flows of 6,000 cfs produced a similar response as the 5,000 cfs flows and flows of 4,000 cfs or lower resulted in significantly reduced population growth of only 37% of years. (*Id*.) The TBI/NRDC analysis suggests that 5,000 cfs may represent an important minimum flow threshold for salmon survival on the San Joaquin River. (*Id*.) Based on abundance to prior flow relationships, TBI/NRDC estimates that average March through June inflows of 10,000 cfs are likely to achieve the salmon doubling goal. (TBI/NRDC 3, p. 16-17.)

In addition to fall pulse flows for adult migration and spring flows to support juvenile emigration, additional flows on the San Joaquin River may be needed at other times of year to support Chinook salmon and their habitat. The 2006 Bay-Delta Plan does not include base flow objectives for the San Joaquin River. However, the Central Valley Regional Board's Water Quality Control Plan for the Sacramento and San Joaquin River Basins does include a year round DO objective of 5.0 mg/l at all times on the San Joaquin River within the Delta. (Central Valley Regional Board 2009,. III-5.0). The 2006 Bay-Delta Plan and the Central Valley Basin Plan also include a DO objective of 6.0 mg/L between Turner Cut and Stockton from September 1 through November 30. (*Id*.)

Current flow conditions on the San Joaquin River result in DO conditions below the existing DO objectives in the fall and winter in lower flow years. These conditions may result in delayed migration and mortality to San Joaquin River Chinook salmon, steelhead and other species. Increased flows would improve DO levels in the lower San Joaquin River. Additional flows at other times of year in the tributaries to the San Joaquin River would also provide improved conditions for steelhead inhabiting tributaries to the San Joaquin River (NMFS 3, p. 105) and would have additional benefits by reducing nutrients pollution and biological oxygen demand. (TBI/NRDC 3, p. 27.)

To reduce crowding of spawning adults during the fall, increased flows in the tributaries may also be needed from November through January to ensure protection of Chinook salmon. (AFRP, p. 12.) However, there is no evidence that increased flows would reduce spawner crowding or improve juvenile production. (*Id*.) Habitat modeling indicates that flows of up to 300 cfs on the San Joaquin River tributaries may provide optimum physical habitat during the fall. (AFRP 2005, p. 14.)

To maintain the ecosystem benefits of a healthy riparian forest, minimum flows and ramping rates for riparian recruitment may also be needed during late spring and early summer. (AFRP 2005, p. 14.) To protect over-summering steelhead and salmon, flows in the tributaries during the summer and fall are needed. To maintain minimal habitat of a suitable temperature (less than 65˚ F), flows between 150 and 325 cfs may be needed on each of the tributaries to the San Joaquin River. (AFRP 2005, pp. 14-15.)

The magnitude, duration, timing, and source of San Joaquin River inflows are important to San Joaquin River Chinook salmon migrating through the Delta and several different aspects of their

life history. Inflows are needed to provide appropriate conditions to cue upstream adult migration to the San Joaquin River and its tributaries, adult holding, egg incubation, juvenile rearing, emigration from the San Joaquin River and its tributaries, and other functions. San Joaquin River inflows are important during the fall to provide attraction flows and are especially important during juvenile emigration periods. Flows on tributaries to the San Joaquin River are also important for egg incubation and rearing, in addition to migration.

As with the Sacramento River inflows, Chinook salmon are the only species considered for the San Joaquin River inflow criteria; discussion of flow criteria for San Joaquin River inflows is therefore continued in Section 5.3, San Joaquin River inflow criteria.

Hydrodynamics

All Central Valley Chinook salmon must migrate out of the Delta as juveniles and back through the Delta as adults returning to spawn. In addition, many Central Valley Chinook salmon also rear in the Delta for a period of time. (DOI 1, p. 53.) Delta exports affect salmon migrating through and rearing in the Delta by modifying tidally dominated flows in the channels. It is, however, difficult to quantitatively evaluate the direct and indirect effects of these hydrodynamic changes. Delta exports can cause a false attraction flow drawing fish to the export facilities where direct mortality from entrainment may occur. (DOI 1, p. 29.) More important than direct entrainment effects, however, may be the indirect effects caused by export operations increasing the amount of time salmon spend in channelized habitats where predation is high. (*Id*.) Steady flows during drier periods (as opposed to pulse flows that occur during wetter periods) may increase these residence time effects. (DOI 1.)

Direct mortality from entrainment at the south Delta export facilities is most important for San Joaquin River and eastside tributary salmon (and steelhead). (DOI 1, p. 29.) Juvenile salmonids emigrate downstream on the San Joaquin River during the winter and spring. Salmonids from the Calaveras River basin and the Mokelumne River basin also use the lower San Joaquin River as a migration corridor. This lower reach of the San Joaquin River between the Port of Stockton and Jersey Point has many side channels leading toward the export facilities that draw water through the channels to the export pumps. (NMFS 3, p. 651.) Particle tracking model (PTM) simulations and acoustic tagging studies indicate that migrating fish may be diverted into these channels and may be affected by flow in these channels. (Vogel 2004, SJRGA 2006, p. 68, SJRGA 2007, pp. 76-77, and NMFS 3, p. 651.) Analyses indicate that tagged fish may be more likely to choose to migrate south toward the export facilities during periods of elevated diversions than when exports are reduced. (Vogel 2004.)

Similarly, salmon that enter the San Joaquin River through Georgiana Slough from the Sacramento River may also be vulnerable to export effects. (NMFS 3, p. 652.) While fish may eventually find their way out of the Central Delta channels after entering them, migratory paths through the Central Delta channels increase the length and time that fish take to migrate to the ocean increasing their exposure to predation, increased temperatures, contaminants, and unscreened diversions. (NMFS 3, p. 651-652.)

PTM analyses indicate that as net reverse flows in Old and Middle rivers increase from -2,500 cfs to -3,500 cfs, particle entrainment changes from 10% to 20% and then again to 40% when flows are -5,000 cfs and 90% when flows are -7,000 cfs. (*Id*.) Based on these findings, NMFS's Opinion includes requirements that exports be reduced to limit negative net Old and Middle river flows to -2,500 cfs to -5,000 cfs depending on the presence of salmonids from January 1 through June 15. (NMFS 3, p. 648.)

In addition to effects of net reverse flows in Old and Middle rivers, analyses concerning the effects of net reverse flows in the San Joaquin River at Jersey Point were also conducted and documented in the USFWS, 1995 *Working Paper on Restoration Needs, Habitat Restoration Actions to Double the Natural Production of Anadromous Fish in the Central Valley California* (1995Working Paper). These analyses show that net reverse flows at Jersey Point decrease the survival of smolts migrating through the lower San Joaquin River. (USFWS 1992b as cited in USFWS 1995b, p. 3Xe-19.) Net reverse flows on the lower San Joaquin River and diversions into the central Delta may also result in reduced survival for Sacramento River fall-run Chinook salmon. (USFWS 1995b, p. 3Xe-19) Based on these factors, the 1995 Working Paper includes a recommendation to maintain positive flows at Jersey Point of 1,000 cfs in critical and dry years, 2,000 cfs in below- and above-normal years, and 3,000 cfs in wet years from October 1 through June 30 to improve survival for all races and stocks of juvenile salmon and steelhead migrating through and rearing in the Delta. (*Id*.)

In addition to relationships between reverse flows and entrainment effects, flows on the San Joaquin River versus exports also appear to be an important factor in protecting San Joaquin River Chinook salmon. Various studies show that, in general, juvenile salmon released downstream of the effects of the export facilities (Jersey Point) have higher survival out of the Delta than those released closer to the export facilities. (NMFS 3-Appendix 3, p. 74.) Studies also indicate that San Joaquin basin Chinook salmon production increases when the ratio of spring flows to exports increases. (DFG 2005, SJRGA 2007 as cited in NMFS 3-Appendix 3, p. 74.) However, it should be noted that flow at Vernalis appears to be the controlling factor. Increased flows in the San Joaquin River in the Delta may also benefit Sacramento basin salmon by reducing the amount of Sacramento River water that is pulled into the central Delta and increasing the amount of Sacramento River water that flows out to the Bay. (NMFS 3, Appendix 3, p. 74-75.) Based on these findings, the NMFS Opinion calls for export restrictions from April 1 through May 31 with Vernalis flows to export ratios ranging from 1.0 to 4.0 based on water year type, with unrestricted exports above flows of 21,750 cfs at Vernalis, in addition to other provisions for health and safety requirements. (NMFS 3, Appendix 3, p.73-74.)

Analyses by TBI/NRDC indicate that Vernalis flow to export ratios above 1.0 during the San Joaquin basin juvenile salmon outmigration period in the spring consistently correspond to higher escapement estimates two and half years later, with more than 10,000 fish in 76% of years. (TBI/NRDC 4, p. 11.) Vernalis flows to export ratios of less than 1.0 correspond to lower escapement estimates two and half years later, with more than 10,000 fish in only 33% of years. (*Id*.) TBI/NRDC estimates that Vernalis flows to export ratios of greater than 4.0 would reach population abundance goals. (TBI/NRDC 4, pp. 11-12.)

Vernalis flows to export ratios also appear to be important during the fall period to provide improved migration conditions for adult fall-run San Joaquin basin Chinook salmon. Adult fall-run San Joaquin basin Chinook salmon migrate upstream through the Delta primarily during October when San Joaquin River flows are typically low. (AFRP 2005, p. 12.) As a result, when exports are high, little if any flow from the San Joaquin basin may make it out to the ocean to help guide San Joaquin basin salmon back to the basin to spawn. (*Id*.) Analyses indicate that increased straying occurs when more than 400% of the flow at Vernalis is exported at the Delta pumping facilities (equivalent to a Vernalis flow to export ratio of 0.25). (*Id*.) Straying rates decreased substantially when export rates were less than 300% of Vernalis flow. (*Id.*)

Export related criteria for salmon are provided in section 5.4, Hydrodynamic Recommendations.

Floodplain Flows

Juvenile salmon will rear on seasonally inundated floodplains when available. Such rearing in the Central Valley, in the Yolo Bypass and the Cosumnes River floodplain, has been found to have a positive effect on growth and apparent survival of juvenile Central Valley salmon through the Delta. (Sommer *et al*. 2001 and Jeffres *et al*. 2005 as cited in DOI 1, p. 27 and Sommer *et al*. 2005 and Jeffres *et al*. 2008 as cited in NMFS 3, p. 609.) The increased growth rates may be due to increased temperatures and increased food supplies. (DOI 1, p. 27, DFG 3, p. 3.) Floodplain rearing provides conditions that promote larger and faster growth which improves outmigration, predator avoidance, and ultimately survival. (Stillwater Science 2003 as cited in DFG 3, p. 6.) Increased survival may also be related to the fact that ephemeral floodplain habitat and other side-channels provide better habitat conditions for juvenile salmon than intertidal river channels during high flow events when, in the absence of such habitat, juvenile salmon may be displaced to these intertidal areas. (Grosholz and Gallo 2006 as cited in DOI 1, p. 27 and Stillwater Science as cited in DFG 3, p. 6.) The improved growing conditions provided by floodplain habitat are also believed to improve ocean survival resulting in higher adult return rates. (Healy 1982, Parker 1971 as cited in DOI 1, p. 28.)

While floodplain habitat is generally beneficial to salmon, it may also be detrimental under certain conditions. Areas with engineered water control structures have comparatively higher rates of stranding. (Sommer *et al*. 2005 as cited in DOI 1, p. 28.) In addition, high temperatures, low DO, and other water quality conditions that may occur on floodplains may adversely affect salmon. (DFG 3, p. 6.) Reduced depth may also make salmon more susceptible to predation. (*Id*.) Water depths of 30 cm or more are believed to reduce the risk of avian predation. (Gawlik 2002 as cited in DFG 3, p. 6.) Further, the most successful native fish are those that use the floodplain for rearing, but leave before the floodplain becomes disconnected to the river. (Moyle *et al*. 2007, DFG 3, p. 6.) From a restoration perspective, projects should be designed to drain completely to minimize formation of ponds in order to avoid stranding. (Jones and Stokes, 1999 as cited in DOI 1, p. 28.) Bioenergetic modeling indicates that with regard to increased temperatures, increased food availability may be sufficient to offset increased metabolic demands from higher water temperatures. (DFG 3, p. 6.) However, as temperatures increase, juveniles may be unable to migrate to areas of lower temperatures due to reduced swimming ability. (DFG 3, p. 7.) As a result, as summer temperatures increase, floodplain habitat should also decrease. (*Id*.)

The timing of floodplain inundation for the protection of Central Valley Chinook salmon should generally occur from winter to mid-spring to coincide with the peak juvenile Chinook salmon outmigration period (which itself generally coincides with peak flows) and to avoid non-native access to the floodplain (which would generally occur in late-spring). (AR/NHI 1, p. 25.) The benefits of floodplain inundation generally increase with increasing duration, with even relatively short periods of two-weeks providing potential benefits to salmon. (Jeffres *et al*., 2008 as cited in AR/NHI 1, p. 25.) Benefits to salmon may also increase with increasing inter-annual frequency of flooding. Repeated pulse flows and associated increased residence times may be associated with increased productivity which would benefit salmon growth rates and potentially reduce stranding. (*Id*.)

Table 4, developed by AR/NHI, provides estimated thresholds for inundating floodplain habitat under existing and potentially modified conditions. Inundation threshold refers to the discharge when floodwaters begin to inundate the floodplain. Target discharge is the amount of water necessary to produce substantial inundation and flow across the floodplain. (Source: AR/NHI 1, p. 30.)

Floodplain inundation criteria for protection of salmon are provided in section 5.6.2, Floodplain Activation, under Other Measures.

Table 4. Inundation Thresholds for Floodplains and Side Channels at Various Locations Along the Sacramento River

Location	Stage (in feet)	Inundation Threshold (cfs)	Target Discharge (avg. cfs)	Gauge Location	Source
Freemont Weir					
Existing crest	33.5	56,000	63,000	Verona	USGS
Proposed notch	17.5	23,100	35,000	Verona	USGS
Sutter Bypass					
Tisdale weir	45.5	21,000		Colusa	NOAA; Feyrer
Tisdail with notch					
Lower Sutter Bypass	25	30,000	30,000	Verona	USGS
Upper Sacramento Meander belt side channels	Various	10,000	12,000	Red Bluff	USGS

American Shad (*Alosa sapidissima*)

Status

This species is not listed pursuant to either the ESA or CESA.

Life History[13]

The American shad (*Alosa sapidissima*) is an anadromous fish, introduced into California in the late 1880s, that has become an important sport fish within the San Francisco Estuary. American shad range from Alaska to Mexico and use major rivers between British Columbia and the Sacramento watershed for spawning. (Moyle 2002.)

American shad adults, at 3 to 5 years of age, return from the ocean and migrate into the freshwater reaches of the Sacramento and San Joaquin rivers during March through May, with peak migration occurring in May (Stevens *et al*. 1987). Within California, the major spawning run occurs in the Sacramento River up to Red Bluff and in the adjoining American, Feather, and Yuba rivers with lesser use of the Mokelumne, Cosumnes, and Stanislaus rivers and the Delta (Moyle 2002). Spawning takes place from May through early July (Stevens *et al*. 1987). Following their first spawning event, American shad will return annually to spawn up to seven years of age (Stevens *et al*. 1987). It is believed that river flow will affect the distribution of first time spawners, with numbers of newly mature adults spawning in rivers proportional to flows at the time of arrival (Stevens *et al*. 1987). Spawning takes place in the main channels of the rivers with flows washing negatively buoyant eggs downstream. Depending upon temperature, larvae hatch from eggs in 3 to 12 days and will remain planktonic for 4 weeks (Moyle 2002).

[13] This section was largely extracted from DFG Exhibit 1, pages 26-27.

The lower Feather River and the Sacramento River from Colusa to the northern Delta provide the major summer nursery for larvae and juveniles. Flows drive the transport of young downstream, with wet years changing the location of the concentration of young and their nursery area further downstream into the northern Delta (Stevens *et al*. 1987). Out migration of young American shad through the Delta occurs from June through November (Stevens 1966). American shad spawned and rearing in the Delta and those that travel through the Delta during out migration are vulnerable to entrainment at the State and federal pumping facilities; catches at the facilities in some years have numbered in the millions (Stevens and Miller 1983). During migration to the ocean, young fish feed upon zooplankton, including copepods, mysids, and cladocerans, as well as amphipods (Stevens 1966, Moyle 2002). Most American shad migrate to the ocean by the end of their first year, but some remain in the estuary (Stevens *et al*. 1987).

Population Abundance and its Relationship to Flow

Year class strength correlates positively with river flow during the spawning and nursery period (April-June). (Stevens and Miller 1983.) American shad exhibit a weak but significant relationship to X2, (Kimmerer 2002a). After 1987, the relationship changed such that abundance increased per unit flow. (Kimmerer 2002a, Kimmerer 2009.) The X2 versus abundance relationship has remained intact into recent years. (Kimmerer *et al*. 2009.) In addition, Kimmerer *et al*. (2009) found that American shad had a habitat relationship (defined by salinity and Secchi depth) to X2 that appeared consistent with its relationship of abundance to X2 (i.e., slopes for abundance versus X2 and habitat versus X2 were similar), which provides some support for the idea that increasing quantity of habitat could explain the X2 relationship for this species (a possible causal mechanism for the abundance versus X2 relationship). Stevens and Miller (1983) determined that the apparent general effect of high flow on all of the species they examined, including American shad, is to increase the quality and quantity of nursery habitat and more widely disperse the young fish, thus reducing density-dependent mortality.

Population Goal

The immediate goal is to maintain viable populations of this species by providing sufficient flows to facilitate attraction of spawners, survival of eggs and larvae, and dispersal of young fish to suitable nursery habitats.

Species-Specific Recommendations

Delta Outflow

The DFG's current science-based conceptual model is that placement of X2 in Suisun Bay represents the best interaction of water quality and landscape for fisheries production given the current estuary geometry. (DFG 2, p. 6.) Maintaining X2 at 75 km and 64 km corresponds to net Delta outflows of approximately 11,400 cfs and 29,200 cfs, respectively. As noted by DFG, X2, in this instance, is a surrogate for tributary and mainstem river inflows to the Delta that support egg and larval survival. The species specific flow criteria to protect American shad shown in Table 5 are consistent with those submitted by DFG. (closing comments, p. 7.)

Inflows

No explicit recommendations for inflows to support American shad were identified in the record. The DFG provided outflow criteria for this species based on positioning X2 in Suisun Bay (DFG closing comments, p. 7); noting that in this instance X2 is a surrogate for tributary and mainstem river inflows. As noted above, year class strength correlates positively with river flow during the spawning and nursery period (April to June). (Steven and Miller 1983.) Flows must be sufficient to attract American shad spawners into Sacramento River tributaries, transport and disperse the young fish to suitable nursery habitat, and reduce the probability of entrainment of young fish

and their food organisms in water diversions. (DFG 1987 [Exh 23, p. 23].) Water development has reduced flows during the spring and early summer periods which are most critical in this respect. (*Id*.) The spawning and nursery period, during which inflows appear to be most critical for this species, generally correspond to important periods for other more sensitive species (e.g., salmon outmigration, longfin smelt spawning and rearing). It is anticipated that by providing sufficient flows to meet the outflow criteria recommended above, favorable river conditions will be provided to support American shad spawning and rearing.

Old and Middle River Flows

American shad spawned and rearing in the Delta and those that travel through the Delta during out migration are vulnerable to entrainment at the State and Federal export facilities; in some years catches at the facilities have numbered in the millions. (Stevens and Miller 1983.) Although evaluations of screening efficiency comparable to studies for striped bass and salmon had not been completed for American shad, DFG believed in 1987 that larger fish in the fall were screened fairly efficiently, while screening efficiencies for newly metamorphosed juveniles in the late spring and early summer were quite low. (DFG 1987 [Exh 23, p. 20].) American shad are notoriously intolerant of handling. Tests have shown that losses of American shad that were successfully screened exceeded 50%during the summer months, with slightly lower mortalities during the cooler fall months. (DFG 1987 [Exh 23, p. 22].) These high handling mortalities suggest the only practical strategy for reducing losses may be pumping schedules that minimize shad entrainment. (*Id.*). However, no recommendations specific to American shad for net OMR flows or pumping restrictions were identified in the record. Net OMR flow criteria are intended to protect salmon, delta smelt, and longfin smelt populations and are also likely to reduce the number of American shad entrained at the export facilities. In addition, restrictions stipulated in the OCAP Biological Opinions (NMFS 3, pp. 648-653; USFWS 2008) will also reduce entrainment of American shad.

Table 5. Delta Outflows to Protect American Shad

Effect or Mechanism	Water Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Spawning; Nursery	All	--	--	--	X2[1] – 75 to 64 km (~11400 – 29200 cfs)			--	--	--	--	--	--
[1] For this species, X2 is a surrogate for tributary and mainstem river inflows to the Delta that support egg and larval survival. Source: DFG 1, p. 26; DFG 2, p. 6, DFG closing comments, p. 7.													

4.2.4 Life History Requirements – Pelagic Species

Following are life history and species-specific requirements for longfin smelt, Delta smelt, Sacramento splittail, starry flounder, Bay shrimp, and zooplankton

Longfin Smelt (*Spirinchus thaleichthys*)

Status

Longfin smelt is listed as a candidate for threatened status under the CESA. (DFG 2010.)

Life History

Longfin smelt are a native species that live two years with females reproducing in their second year. Both juveniles and adults feed on zooplankton. Longfin smelt is an anadromous, open water species moving between fresh and salt water. Adults spend time in San Francisco Bay and may go outside the Golden Gate for short periods. Adults aggregate in Suisun Bay and the

western Delta in late fall and migrate upstream to spawn in freshwater as water temperatures drop below 18˚C. (Baxter *et al*. 2009.) The spawning habitat is between the confluence of the Sacramento and San Joaquin rivers (around Point Sacramento) to Rio Vista on the Sacramento side and Medford Island on the San Joaquin River. Spawning activity appears to decrease with distance from the low salinity zone, so the location of X2 influences how far spawning migrations extend into the Delta. (Baxter *et al*. 2009.) Spawning takes place between November and April with peak reproduction in January. Eggs are deposited on the bottom and hatch between December and May into buoyant larvae. Peak hatch is in February. Net Delta outflow transports the larvae and juvenile fish to higher salinity water.

Population Abundance and its Relationship to Flow

The population abundance of longfin smelt is positively correlated with spring Delta outflow and inversely related to net OMR spring reverse flows. The correlations are interpreted to mean that net Delta outflow and net reverse OMR flows are, at least partially, responsible for controlling the abundance of longfin smelt. Modifications in the two flow regimes are intended to begin to stabilize and increase the population abundance of longfin smelt. Each correlation is discussed below.

The population abundance of longfin smelt is positively related to Delta outflow during winter and spring. (Jassby *et al*. 1995; Rosenfield and Baxter 2007; Kimmerer 2002a; Kimmerer *et al*. 2009.) The statistically strongest outflow averaging period is January-June. The abundance relationships are from the fall mid-water trawl (FMWT) survey, the bay study mid-water trawl, and the bay study otter trawl. All three surveys show statistically significant positive relationships between the abundance of juveniles/adults and Delta outflow. There has been a decrease in the carrying capacity of the estuary since 1988, presumably because of the invasion of the clam *Corbula*, but the overall winter spring relationship is still statistically significant. More spring outflow results in more smelt as measured by all three indices. The biological basis for the spring outflow relationship is not known. Baxter et al. (2009) speculate that the larvae may benefit from increased downstream transport, increased food production, and a reduction in entrainment losses at the SWP and CVP pumps.

The population abundance of juvenile and adult longfin smelt, as measured by the FMWT index, is also inversely related to the number of fish salvaged at the SWP and CVP pumping facilities. (TBI/NRDC 4, pp. 19-20.) High pumping rates at the two facilities cause net OMR reverse flows which passively move all age groups of longfin smelt toward entrainment at the pumps. A subset of the juvenile and adult populations are counted at the pumping facilities. Larval longfin smelt (<20 mm) pass through the louvers and are not counted. Peak adult and juvenile longfin smelt salvage occurs in January and April to May, respectively. (Baxter *et al*. 2009.) Entrainment of larval smelt, although not counted, are likely greatest between March and April. (TBI/NRDC 4, p.16.) Adult and juvenile longfin smelt salvage is an inverse logarithmic function of net OMR flows. (Grimaldo *et al*. 2009.) Increasing OMR reverse flows results in an exponential increase in salvage loss. Juvenile longfin smelt salvage is a negative function of Delta outflow between March and May. (TBI/NRDC 4, p.17.) Higher outflow in these three months results in lower entrainment loss. This may result from the fact that during low outflow years spawning occurs higher in the system, placing adults and subsequent larvae and juveniles closer to the pumps. Also, negative net OMR flows can either passively draw fish to the pumps or at high levels mis-cue them as to the direction of higher salinity. A consequence is that juvenile longfin smelt are most in danger of entrainment at the CVP and SWP pumping facilities during low outflow years with high net negative OMR flows.

The OMR flow results discussed above are consistent with the findings of Baxter *et al* (2009). The authors used the Delta Simulation Model (DSM2, PTM subroutine) to predict the fate of larval longfin smelt. The PTM predicted that larval entrainment at the SWP might be substantial (2 to10%), particularly during the relatively low outflow conditions modeled. Baxter *et al*. (2009) also identified a significant negative relationship between spring (April to June) net negative OMR flows and the sum of combined SWP and CVP juvenile longfin smelt salvage. Juvenile longfin smelt salvage increased rapidly as OMR became more negative than -2,000 cfs. However, as winter-spring or just spring outflows increased, shifting the position of X2 downstream, the salvage of juvenile longfin smelt decreased significantly. Also, particle entrapment decreased, even with a high negative net OMR, when the flow of the Sacramento River at Rio Vista increased above 40,000 cfs. Entrainment of particles almost ceased at flows of 55,000 cfs.

TBI/NRDC (TBI/NRDC 2, pp. 15-19) conducted a generation to generation population abundance analysis for longfin smelt versus Delta outflow. The authors found that the probability of an increase in the FMWT longfin smelt index was greater than 50% in years when Delta outflow averaged 51,000 and 35,000-cfs between January to March and March to May, respectively. The analysis is important because it suggests a potential outflow trigger for growing the population.

There is also evidence that longfin smelt is food limited. (SFWC 1, p.59.) The FMWT index for longfin smelt is positively correlated in a multiple linear regression with the previous spring's *Eurytemora affinis* abundance (an important prey organism) after weighting the data by the proportion of smelt at each *Eurytemora* sampling station and normalizing by the previous years FMWT index. The spring population abundance of *Eurytemora* has itself been positively correlated with outflow between March and May since the introduction of *Corbula.* (Kimmerer, 2002a.) The positive correlation between *Eurytemora* abundance and spring outflow provides further support for a spring outflow criterion.

Longfin smelt populations are at an all time low. The average FMWT index for years 2001-2009 are only 3 percent of the average value for 1967 to 1987, a time period when pelagic fish did better in the estuary. The FMWT index for two of the last three years is the lowest on record.

Delta outflow recommendations to protect longfin smelt received from participants are summarized in Table 6. The DFG (DFG closing comments, p.7) recommended a Delta outflow between 12,400 and 28,000 cfs from January to June of all water year types to help transport larval/juvenile longfin smelt seaward in the estuary. TBI/NRDC (TBI/NRDC 2, pp. 19-26; TBI/NRDC Closing Comments, pp. 6-7) also made spring Delta outflow recommendations based on five sets of hydrologic conditions for the Central Valley. The TBI/NRDC recommendations range between 14,000 and 140,000 cfs for January through March and 10,000 to 110,000 cfs between April and May. The TBI/NRDC recommendations are based on their longfin smelt population abundance analysis which demonstrated positive growth in years with high spring outflow.

The four sets of OMR recommendations to protect longfin smelt received from participants are summarized in Table 7. TBI/NRDC (TBI/NRDC 4, pp. 21 and 30; TBI/NRDC closing comments, p. 11) recommended reducing entrainment losses of longfin smelt in dry years (March to May when outflow is less than 18,000 cfs) and population abundance is low (FMWT index less than 500) by maintaining positive net OMR flows in April and May. Alternatively, if the index is greater than 500 and Delta outflow is low, then net OMR flows should not be more negative than -1,500 cfs. The DOI (DOI 1, p.53) made a non-species specific recommendation that OMR

flows should be positive in all months between January and June. CSPA/CWIN made a non-species specific recommendations that combined export rates equal zero from mid-March through June. (CSPA 1, p.8; CWIN 2, p. 26.) Finally, the DFG has issued an Incidental Take Permit for longfin smelt (2081-2009-001-03) that restricts net OMR flows in some years based on the recommendations of the Delta Smelt Workgroup. (Baxter *et al*. 2009.)

Table 6. Participant Recommendations for Delta Outflow to Protect Longfin Smelt

Organization	Water Year	Jan	Feb	Mar	April	May	Jun
TBI/NRDC	81-100% (driest years)	14,000 – 21,000			10,000 – 17,500		3000 – 4200
	61-80%	21,000 – 35,200			17,500 – 29,000		4200 – 5000
	41-60%	35,200 – 55,000			29,000 – 42,000		5000 – 8500
	21-40%	55,000 – 87,500			42,000 – 62,500		8500 – 25000
	0-20% (wettest years)	87,500 – 140,000			62,500 – 110,000		25000 – 50000
DFG	all	12,400 to 28,000					

Population Goal

The immediate goal is to stabilize the longfin smelt population, as measured by the FMWT index, and to begin to grow the population. The long-term goal is to achieve the objective of the Recovery Plan for the Sacramento/San Joaquin Delta Native Fishes (USFWS 1996). The plan states that longfin smelt will be considered recovered when its abundance is similar to the 1967 to 1984 period.

Species- Specific Recommendations

Table 8 contains the species-specific flow criteria to protect longfin smelt. The purpose of the Delta outflow criteria is to stabilize and begin to grow the longfin smelt population; positive population growth is expected in half of all years with these flows. The net OMR flow criteria are intended to protect the longfin smelt population from entrainment in the CVP and SWP pumping facilities during years with limited Delta outflow (dry and critically dry years). As noted above, longfin smelt spawn in the Delta on both the Sacramento and San Joaquin rivers. Longfin smelt optimally need positive flow on both river systems to move buoyant larvae downstream and away from the influence of the pumps.

Table 7. Participant Recommendations for Net OMR Reverse Flows to Protect Longfin Smelt

Organization	Water Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
2006 Bay-Delta Plan	all	Some restrictions, given in terms of E/I ratios											
DFG Take Permit	all	-1,250 to -5,000[1]											
TBI/NRDC	C/D				>0[2] or -1,500[3]								
DOI	all	>0											
CSPA/CWIN	all			Combined export rates = 0									

[1] This condition is not likely to occur in many years and is based on requirements in the DFG Incidental Take Permit 2081-2009-001-03 and the advice of the Smelt Working Team. The condition is most likely to occur in dry or critical years when longfin smelt spawn higher in the Delta and hydrology does not rapidly transport hatched larvae from the central and south Delta.

[2] If FMWT index is less than 500

[3] If FMWT index is greater than 500

Table 8. Delta Outflows to Protect Longfin Smelt

Flow Type	Water Year Type	Jan	Feb	Mar	April	May	Jun
Net Delta Outflow	C	14,000 – 21,000			10,000 – 17,500		3,000 – 4,200
	D	21,000 – 35,200			17,500 – 29,000		4,200 – 5,000
	BN	35,200 – >50,000			29,000 – 42,000		5,000 – 8,500
	AN	>50,000			>42,000		8,500 – 25,000
	W	>50,000			>42,000		25,000 – 50,000
OMR	C/D				>0[1] or -1,500[2]		

[1] If FMWT index is less than 500

[2] If FMWT index is greater than 500

Delta Smelt (*Hypomesus transpacificus*)

Status
Delta smelt is listed as endangered under the CESA and threatened under the ESA. (DFG 2010.)

Life History
Delta smelt are endemic to the Delta. Delta smelt have an annual, one-year life cycle although some females may live and reproduce in their second year. (Bennett 2005.) Delta smelt complete their entire life cycle in the Delta and upper estuary. Delta smelt feed primarily on planktonic copepods, cladocerans, and amphipods. (Baxter *et al*. 2008.) In September or October delta smelt begin a slow upstream migration toward their freshwater spawning areas in the upper Delta, a process that may take several months. (Moyle 2002.) The upstream migration may be triggered by Sacramento River flows in excess of 25,000 cfs. (DSWG 2006.) Spawning can occur from late February to July, although most reproduction appears to take place between early April and mid-May. (Moyle 2002.) Spawning areas include the lower Sacramento, Mokelumne, and San Joaquin rivers, the west and south Delta, Suisun Bay, Suisun Marsh, and occasionally in wet years, the Napa River. (Wang 2007.) Eggs are negatively buoyant and adhesive with larvae hatching in about 13 days. (Wang, 1986; Mager 1996.) Upon hatching, the larvae are semi-buoyant staying near the bottom. Within a few weeks, larvae develop an air bladder and become pelagic, utilizing vertical water column movement to maintain their longitudinal position in the estuary. (Moyle 2002.)

Freshwater outflow during spring (March to June) affects the distribution of larvae by transporting them seaward toward the low salinity zone. (Dege and Brown 2004.) High Delta outflow during spring can carry some smelt downstream of their traditional rearing areas in the west Delta and Suisun Bay and into San Pablo Bay where long-term growth and survival may not be optimal. Conversely, periods of low outflow increase residence time in the Delta. Increasing residence time in the Delta probably prolongs the exposure of delta smelt to higher water temperatures and increased risk of entrainment at the State and Federal pumping facilities. (Moyle 2002.) Ideal rearing habitat conditions are believed to be shallow water areas most commonly found in Suisun Bay. (Bennett 2005.) When the mixing zone was located in Suisun Bay, it may in the past have provided optimal conditions for algal and zooplankton growth, an important food source for delta smelt. (Moyle 2002.) However, the quality of habitat in Suisun Bay appears to have deteriorated with the introduction of the clam *Corbula* which now consumes much of the phytoplankton that previously supported large populations of zooplankton. Since 2005, approximately 40% of the delta smelt population now remains in the Cache Slough complex north of the Delta. This may represent an alternative life history strategy in which the fish stay upstream of the low salinity zone (LSZ) through maturity. (Sommer et al., 2009.)

Population Abundance and Relationship to Flow
Delta smelt population abundance is measured in the summer tow net survey, the FMWT survey and the 20-mm spring-summer survey of juvenile fish. (Kimmerer et al. 2009.) All three indices indicate that delta smelt populations are at an all time low and may be in danger of extinction. The average FMWT index for 2001-2009 is only 20% of the value measured between 1967 and 1987, a time period when pelagic fish did better in the estuary. FMWT indices for the last six years (2004 to 2009) include all of the lowest values on record. The cause of the decline is unclear but likely includes some combination of flow, export pumping, food limitation, and introduced species.

Three types of flow have been hypothesized to affect delta smelt abundance. These are spring and fall Delta outflow and net OMR reverse flow. Testimony was received at the public proceeding recommending management changes to all three types of flow (Table 9 and Table 10). In the past, there has been a weak negative relationship between spring Delta outflow and delta smelt abundance as measured by the FMWT, however, the relationship has now disappeared. (Kimmerer *et al*. 2009.) The cause for the disappearance of the spring outflow-abundance relationship is not known but may result from the deterioration of rearing habitat in Suisun Bay because of colonization by the clam *Corbula.*

Several organizations recommend fall Delta outflow criteria for protection of delta smelt (Table 9). The primary purpose of a fall Delta outflow criterion is to increase the quality and quantity of rearing habitat for Delta smelt. (Nobriga et al. 2008; Feyrer et al. 2007; Feyrer et al., in review.) Rearing habitat is hypothesized to increase when the fall LSZ is downstream of the confluence of the Sacramento and San Joaquin rivers. This corresponds to Delta outflows greater than about 7,500 cfs between September and November, which would have to be achieved by release of water from upstream reservoirs in most years. Grimaldo et al. (2009) found that X2 was a predictor for salvage of adult delta smelt at the intra-annual scale when net OMR flows were negative. Moving X2 westward in the fall serves to increase the geographic and hydrologic distance of delta smelt from the influence of the export facilities and therefore likely reduces the risk of entrainment. (DOI 1, p. 34.) The USFWS (2008) recommended in their Opinion that the LSZ be maintained in the fall of above normal and wet water year types in Suisun Bay (Action 4). The action was restricted to above average water years to insure that sufficient cold water pool resources remained for steelhead and salmon and because these are the years in which SWP and CVP operations have most significantly affected fall conditions. (USFWS 2008.) The National Academy of Sciences (NAS) (2010) commented on this action in their review:

> ”The statistical relationship is complex. When the area of highly suitable habitat is low, either high or low FMWT indices can occur. In other words, delta smelt can be successful even when habitat is restricted. More important, however, is that the lowest abundances all occurred when the habitat-area index was less than 6,000 ha. This could mean that reduced habitat area is a necessary condition for the worst population collapses, but it is not the only cause of the collapse The action is conceptually sound to the degree that the amount of habitat available for smelt limits their abundance however the weak statistical relationship between the location of X2 and the size of smelt populations makes the justification for this action difficult to understand.” The National Academy of Sciences noted approvingly that the U.S. Fish and Wildlife Service (2008) required “additional studies addressing elements of the habitat conceptual model to be formulated and implemented promptly.”

Table 9. Participant Recommendations for Delta Outflows to Protect Delta Smelt

	Water Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
2006 Bay-Delta Plan [1]	C	4500 [2]	7100 – 29200 [3]					4000	3000	3000	3000	3500	
	D	4500	7100 - 29200					5000	3500	3000	4000	4500	
	BN	4500	7100 - 29200					6500	4000	3000	4000	4500	
	AN	4500	7100 - 29200					8000	4000	3000	4000	4500	
	W	4500	7100 - 29200					8000	4000	3000	4000	4500	
USFWS Opinion[1]	AN									7000 [4]			
	W									12400			
EDF/Stillwater Sciences	C			26800	17500	17500	7500	4800	4800	4800	4800	4800	
	D			26800	17500	17500	7500	4800	4800	4800	4800	4800	
	BN			26800	26800	26800	11500	7500	7500	7500	7500	7500	
	AN			26800	26800	26800	11500	11500	11500	11500	11500	11500	
	W			26800	26800	26800	17500	17500	17500	17500	17500	17500	
TBI/NRDC	81-100%									5750 - 7500			
	61-80%									7500 - 9000			
	41-60%									9700 - 12400			
	21-40%									12400 - 16100			
	0-20%									16100 - 19000			

[1] 2006 Bay-Delta Plan and USFWS Opinion flows shown for comparative purposes.

[2] All water year types - Increase to 6000 if the December Eight River Index is > than 800 thousand acre-feet (TAF).

[3] Minimum Delta outflow calculated from a series of rules that are described in Tables 3 and 4 of the 2006 Bay-Delta Plan.

[4] USFWS Opinion (RPA concerning Fall X2 requirements [pp282-283] - improve fall habitat [quality and quantity] for delta smelt) (references USFWS 2008, Feyrer *et al* 2007, Feyrer *et al* in revision) - September-October in years when the preceding precipitation and runoff period was wet or above normal, as defined by the Sacramento Basin 40-30-30 Index, USBR and DWR shall provide sufficient Delta outflow to maintain monthly average X2 no greater than 74 km and 81 km in Wet and Above Normal years, respectively. During any November when the preceding water year was wet or above normal, as defined by Sacramento Basin 40-30-30 index, all inflow into the CVP/SWP reservoirs in the Sacramento Basin shall be added to reservoir releases in November to provide additional increment of outflow from Delta to augment Delta outflow up to the fall X2 of 74 km and 81 km for wet and above normal water years, respectively. In the event there is an increase in storage during any November this action applies, the increase in reservoir storage shall be released in December to augment the December outflow requirements in the 2006 Bay-Delta Plan.

Table 10. Participant Recommendations for Net OMR Flows to Protect Delta Smelt

	Water Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
2006 Bay-Delta Plan	all	Some restrictions, given in terms of exports to inflow ratios											
USFWS - Opinion	all	Action 1: -2000 cfs for 14 days once turbidity or salvage trigger has been met; Action 2: range btw -1250 and -5000 cfs [1]			Range between -1,250 and -5,000 [2]								See Jan-Mar
USFWS	all	>0 [3]											
CSPA/ CWIN				Combined Export Rates = 0[3]									
TBI/ NRDC	all	>-1,500 cfs											>-1500 cfs

[1] USFWS Opinion - RPA re: net OMR flows. Component 1 - Adults (December - March) - Action 1 (protect upmigrating delta smelt) - once turbidity or salvage trigger has been met, -2000 cfs OMR flow for 14 days to reduce flows towards the pumps. Action 2 (protect delta smelt after migration prior to spawning) – Net OMR flow range between -1250 and -5000 cfs determined using adaptive process until spawning detected. (pp.280-282.)

[2] USFWS Opinion - RPA re: net OMR flows. Component 2 - Larvae/juveniles - action starts once temperatures hit 12° C at three Delta monitoring stations or when spent female is caught. Net OMR flow range between -1250 and -5000 cfs determined using adaptive process. OMR flow restrictions continue until June 30 or when Delta water temperatures reach 25° C, whichever comes first. (pp. 280-282.)

[3] Recommendations by the USFWS and CSPA/CWIN were not species specific.

It should be reiterated that this measure should be implemented within an adaptive framework, including completing studies designed to clarify the mechanism(s) underlying the effects of fall habitat on the delta smelt population, and a comprehensive review of the outcomes of the action and its effectiveness. Until additional studies are conducted demonstrating the importance of fall X2 to the survival of delta smelt, additional fall flows, beyond those stipulated in the fall X2criteria, for the protection of delta smelt are not recommended if it will compete with preservation of cold water pool resources needed for the protection of salmonids.

Net negative OMR flows can affect delta smelt by pulling them into the central Delta where they are at risk of entrainment in the SWP and CVP pumps. Recent studies have shown that entrainment of delta smelt and other pelagic species increases as net OMR flows become more negative. (Grimaldo et al. 2009; Kimmerer 2008.) Delta smelt are at risk as juveniles in the spring during downstream migration to their rearing area, and as adults between the fall and early spring as they move upstream to spawn. Salvage of age-0 delta smelt at the SWP /CVP fish collection facilities at the intra-annual scale has been found to be related to the abundance of these fish in the Delta, while net OMR flows and turbidity were also strong predictors. (Grimaldo et al. 2009.) This suggests that within a given year, the mechanism influencing entrainment is probably a measure of the degree to which their habitat overlaps with the hydrodynamic "footprint" of net negative OMR flows. (Grimaldo et al. 2009.) PTM results suggest that entrainment is a function of both net OMR flows and river outflows. (Kimmerer and Nobriga 2008.) PTM results may be more applicable to neutrally buoyant larvae and poorly swimming juveniles than adult delta smelt. Particle entrainment increased as a logarithmic function of increasing net negative OMR flows and decreases in river outflows. The highest entrainment was observed at high net negative OMR flows and low outflows. PTM results suggest that entrainment losses might be as high as 40% of the total delta smelt population in some years. (Kimmerer 2008.) Similar results were obtained by Baxter et al. (2009) when evaluating entrainment of longfin smelt using PTM. Juvenile longfin smelt salvage increased rapidly as net OMR flows became more negative than -2,000 cfs. Also, particle entrapment decreased, even with high net negative OMR flows, when the flow of the Sacramento River at Rio Vista increased above 40,000 cfs. Entrainment of particles almost ceased at flows of 55,000 cfs.

Field population investigations support some of the spring PTM results. Gravid females and larvae are present in the Delta as early as March and April. (Bennett 2005.) However, analysis of otolith data on individuals collected later in the year by Bennett *et al*. (unpublished data) show that few of the early progeny survived if spawned prior to the VAMP time period (typically April 15 to May 15). The hydrodynamic data showed high net negative OMR flows in the months preceding and after the VAMP, leading the researchers to conclude that high winter and early spring net negative OMR flows were selectively entraining the early spawning and/or early hatching cohort of the delta smelt population. However, Baxter *et al*. (2008) stated that "under this hypothesis, the most important result of the loss of early spawning females would manifest itself in the year following the loss, and would therefore not necessarily be detected by analyses relating fall abundance indices to same-year predictors." No statistical relationships have been found between either OMR flows or CVP and SWP pumping rates and Delta smelt population abundance. (Bennett 2005.)

Entrainment of adult delta smelt occurs following the first substantial precipitation event ("first flush"), characterized by sudden increases in river inflows and turbidity, in the

estuary as they begin their migration into the tidal freshwater areas of the Delta. (Grimaldo *et al*. 2009.) Patterns of adult entrainment are distinctly unimodal, suggesting that migration is a large population-level event, as opposed to being intermittent or random. (DOI 1, p. 36.) Grimaldo *et al*. (2009) provided evidence suggesting that entrainment during these "first flush" periods could be reduced if export reductions were made at the onset of such periods.

The USFWS Opinion identifies turbidity criteria for which to trigger first flush export reductions, but total Delta outflow greater than 25,000 cfs could serve as an alternate or additional trigger since such flows are highly correlated with turbidity. (Grimaldo *et al*. 2009, DOI 1, p. 36.) Managing OMR flows to thresholds at which entrainment or populations losses increase rapidly, represents a strategy for providing additional protection for adult delta smelt in the winter period (Dec-Mar). (DOI 1, p.36.). The USFWS Opinion identified the lower net OMR flow threshold as - 5000 cfs based on observed OMR flow versus salvage relationships from a longer data period (USFWS 2008) and additional data summarized over a more recent period. (Grimaldo et al. 2009.) The -5000 cfs OMR flow threshold is appropriate because it is the level where population losses consistently exceed 10%. (USFWS 2008, DOI 1, p. 36.) Adult delta smelt entrainment varies according to their distribution in the Delta following their upstream migration. The population is at higher entrainment risk if the majority of the population migrates into the south Delta, which may require net OMR flows to be more positive than -5000 cfs to reduce high entrainment. Conversely, if the majority of the population migrates up the lower Sacramento River or north Delta, a smaller entrainment risk is presumed, which would allow for OMR flows to be more negative than -5000 cfs for an extended period of time, or until conditions warrant a more protective OMR flow. (DOI 1, p.36.)

The USFWS Opinion for delta smelt includes net negative OMR flow restrictions to protect both spawning adult and out-migrating young. Component 1 of the USFWS Opinion has two action items; both are to protect adult delta smelt. Action 1 restricts OMR flow in fall to -2,000 cfs for 14 days when a turbidity or salvage trigger has been met. Both triggers have previously been correlated with the upstream movement of spawning adult smelt. Action 2 commences immediately after Action 1. Action 2 is to protect adult delta smelt after migration, but prior to spawning, by restricting net OMR flows to between -1250 and -5,000 cfs based on the recommendations of the Delta Smelt Workgroup. Component 2 of the USFWS Opinion is to protect larval and juvenile fish. Component 2 actions start once water temperatures hit 12^{o}C at three monitoring stations in the Delta or when a spent female is caught. OMR flows during this phase are to be maintained more positive than -1,250 to -5000 cfs based on a 14-day running average. Component 2 actions are to continue until June 30 or when the 3-day-mean water temperature at Clifton Court Forebay is 25^{o}C. The Delta Smelt Working Group is to make recommendations on the specific OMR flow restrictions between -1250 and -5000 cfs.

The NAS (2010) reviewed the USFWS Opinion OMR flow restrictions and concluded:

> " it is scientifically reasonable to conclude that high negative OMR flows in winter probably adversely affect smelt populations. Thus, the concept of reducing OMR negative flows to reduce mortality of smelt at the SWP and CVP facilities is scientifically justified but the data do not permit a confident identification of the threshold values to use and do not

> permit a confident assessment of the benefits to the population As a result, the implementation of this action needs to be accompanied by careful monitoring, adaptive management and additional analyses that permit regular review and adjustment of strategies as knowledge improves."

The negative impact of negative OMR flows on delta smelt, like on longfin smelt, is likely to be greatest during time periods with high negative OMR flows and low Sacramento River outflow. (Baxter *et al*. 2009; Kimmerer and Nobriga 2008.) The work of Grimaldo *et al*, (2009) suggests that impacts associated with the export facilities can be mitigated on a larger scale by altering the timing and magnitude of exports based on the biology of the fishes and changes in key physical and biological variables.

For the protection of longfin smelt, Delta outflow criteria between January and March range from 35,000 cfs in below normal water years to greater than 50,000 cfs in wet water years (Table 8). For the protection of longfin smelt, flow criteria between April and May range from 29,000 cfs to more than 42,000 cfs. These flows should also afford protection for larval delta smelt from excessive negative OMR flows and entrainment at the CVP and SWP pumping facilities. Under this criterion, lower outflows will still likely occur during critically dry and dry water year types (Table 6). These outflows may not be sufficient to prevent longfin and delta smelt entrainment at the pumping facilities. Therefore, the recommended criterion for longfin smelt specifies that net OMR flows should not be more negative than -1500 cfs in April and May of dry and critically dry water years to protect longfin smelt. The State Water Board determines that this criterion should be extended to include March and June of dry and critically dry water years to protect early and late spawning delta smelt (Table 11).

Minimizing net negative OMR flows during periods when adult delta smelt are migrating into the Delta could also substantially reduce mortality of the critical life stage. For example, one potential strategy is to reduce exports during the period immediately following the "first flush", based on a turbidity or flow trigger. (Grimaldo et al. 2009.) This supports a recommendation that net OMR flows be more positive than -5000 cfs during the period between December and March. Additional OMR flow restrictions may be warranted during periods when a significant portion of the adult delta smelt population migrates into the south or central Delta. In such instances, the determination of specific thresholds should be made through an adaptive approach that takes into account a variety of factors including relative risk (e.g., biology, distribution and abundance of fishes), hydrodynamics, water quality, and key physical and biological variables. The State Water Board agrees with the NAS (2010) that the data, as currently available, do not permit a confident assessment of the threshold OMR flow values nor of the overall benefit to the delta smelt population. Development of a comprehensive life-cycle model for delta smelt would be valuable in that it would allow for an assessment of population level impacts associated with entrainment. Such life-cycle models for delta smelt are currently under development. Therefore, net OMR flow criteria need to be accompanied by a strong monitoring program and adaptive management to adjust OMR flow criteria as more knowledge becomes available.

Delta smelt are food limited. Delta smelt survival is positively correlated with zooplankton abundance. (Feyrer et al., 2007; Kimmerer 2008; Grimaldo et al., 2009.) A new analysis by the SFWC (SFWC 1, p.60) also demonstrates a positive relationship between FMWT delta smelt indices and the previous spring and summer abundance of

Eurytemora and *Psuedodiaptomus.* There are several hypotheses for the cause of the decline in zooplankton abundance. First, zooplankton abundance in Suisun and Grizzly bays, prime habitat for delta smelt, declined after the introduction of the invasive clam *Corbula. Corbula* is thought to compete directly with zooplankton for phytoplankton food and lower phytoplankton levels may limit zooplankton abundance. A second hypothesis is that changes in nutrient loading and nutrient form in the Delta that result from the SRWTP discharge can have major impacts on food webs, from primary producers through secondary producers to fish. (Glibert, 2010.) Changes in nutrient concentrations and their ratios may have caused the documented shift in phytoplankton species composition from large diatoms to smaller, less nutritious algal forms for filter feeding organisms like zooplankton. If true, both of the above hypotheses could indirectly result in lower densities of delta smelt. Therefore, all recommended flow modifications should be accompanied by a strong monitoring and adaptive management process to determine whether changes in OMR flows result in an improvement in delta smelt population levels.

Population Abundance Goal

The immediate goal is to stabilize delta smelt populations, as measured by the FMWT index, and begin to grow the population. The long term goal should be to achieve the objective of the Recovery Plan for the Sacramento/San Joaquin Delta Native Fishes (USFWS 1996.)

Species-Specific Recommendations

Although a positive correlation between Delta outflows and delta smelt is lacking, Delta outflows do have significant positive effects on several measures of delta smelt habitat. (Kimmerer *et al*. 2009), and spring outflow is positively correlated with spring abundance of *Eurytemora affinis* (Kimmerer 2002a), an important delta smelt prey item. No specific spring Delta outflow criteria are therefore recommended for delta smelt. Flow criteria to protect longfin smelt in the spring of wetter years (Table 8) may, however, afford some additional protection for the Delta smelt population.

The State Water Board advances the OMR flow criteria in Table 11 for dry and critically dry years to protect the delta smelt population from entrainment in the CVP and SWP pumping facilities during years with limited Delta outflow. The OMR flow restrictions are an extension of the criteria for longfin smelt. In addition, the State Water Board includes criteria for OMR flows to be more positive than -5,000 cfs between December and February of all water year types to protect upstream migrating adult delta smelt. The -5,000 cfs criteria may need to be made more protective in years when delta smelt move into the central Delta to spawn. The more restrictive OMR flows would be recommended after consultation with the USFWS's Delta Smelt Working Group. In the absence of any other specific information, the State Water Board determines that the existing 2006 Bay-Delta Plan Delta outflow objectives for July through December are needed to protect delta smelt.

Table 11. Net OMR Flows for the Protection of Delta Smelt

Flow Type	Water Year Type	Dec	Jan	Feb	Mar - June
Net OMR flows	C/D				> -1,500 cfs
Net OMR flows	All	> - 5000 cfs (thresholds determined through adaptive management)			

Sacramento Splittail (*Pogonichthys macrolepidotus*)

Status

Sacramento splittail is currently recognized by the DFG as a species of special concern. Splittail was listed as a threatened species pursuant to the ESA in 1999; however, its status was remanded in 2003 on the premise of recent increases in abundance and population stability. This decision was subsequently challenged and the USFWS is revisiting the status of splittail and will make a new 12-month finding on whether listing is warranted by September 30, 2010.

Life History

Sacramento splittail (*Pogonichthys macrolepidotus*) is a cyprinid native to California that can live seven to nine years and has a high tolerance to a wide variety of water quality parameters including moderate salinity levels. (Moyle 2002, Moyle et al. 2004.)

Adult splittail are found predominantly in Suisun Marsh, Suisun Bay, and the western Delta, but are also found in other brackish water marshes in the San Francisco Estuary as well as the fresher Delta. Splittail feed on detritus and a wide variety of invertebrates; non-detrital food starts with cladocerans and aquatic fly larvae on the floodplains, progresses to insects and copepods in the rivers, and to mysid shrimps, amphipods and clams for older juveniles and adults. (Daniels and Moyle 1983, Feyrer et al. 2003, Feyrer et al. 2007a, as cited in DFG 1, p. 13.) In winter and spring when California's Central Valley experiences increased runoff from rainfall and snowmelt, adult splittail move onto inundated floodplains to forage and spawn. (Meng and Moyle 1995; Sommer et al. 1997, Moyle et al. 2004, as cited in DFG 1, p. 13.) Spawning takes place primarily between late February and early July, and most frequently during March and April (Wang 1986, Moyle 2002) and occasionally as early as January. (Feyrer et al. 2006a.) Splittail eggs, laid on submerged vegetation, begin to hatch in a few days and the larval fish grow fast in the warm and food rich environment. (e.g., Moyle et al. 2004, Ribeiro et al. 2004.) After spawning, the adult fish move back downstream.

Once they have grown a few centimeters, the juvenile splittail begin moving off of the floodplain and downstream into similar habitats as the adults. These juveniles become mature in two to three years. In the Yolo Bypass, two flow components appear necessary for substantial splittail production (Feyrer et al. 2006a): (1) inundating flows in winter (January to February) to stimulate and attract migrating adults; and (2) sustained floodplain inundation for 30 or more days from March through May or June to allow successful incubation through hatching (3 to 7 days, see Moyle 2002), and extended rearing until larvae are competent swimmers (10 to 14 days; Sommer et al. 1997) and beyond to maximize recruitment. (DFG 1, p. 13.)

Large-scale spawning and juvenile recruitment occurs only in years with significant protracted (greater than or equal to 30 days) floodplain inundation, particularly in the

Sutter and Yolo bypasses. (Meng and Moyle 1995, Sommer et al. 1997, Feyrer et al. 2006a, as cited in DFG 1, p. 13.) Some spawning also occurs in perennial marshes and along the vegetated edges of the Sacramento and San Joaquin rivers. (Moyle et al. 2004.) During periods of low outflow, splittail appear to migrate farther upstream to find suitable spawning and rearing habitats. (Feyrer et al. 2005.) Moyle et al. (2004) noted that though modeling shows splittail to be resilient, managing floodplains to promote frequent successful spawning is needed to keep them abundant.

Population Abundance and its Relationship to Flow

Age-0 splittail abundance has been significantly correlated to mean February through May Delta outflow and days of Yolo Bypass floodplain inundation, representing flow/inundation during the incubation and early rearing periods. (Meng and Moyle 1995, Sommer et al. 1997.) The flow-abundance relationship is characterized by increased abundance (measured by the FMWT) as mean February–May X2 decreases, indicating a significant positive relationship between FMWT abundance and flow entering the estuary during February–May. (Kimmerer 2002a.)

Feyrer et al. (2006a) proposed the following lines of evidence to suggest the mechanism supporting this relationship for splittail lies within the covarying relationship between X2 and flow patterns upstream entering the estuary: the vast majority of splittail spawning occurs upstream of the estuary in freshwater rivers and floodplains (Moyle et al. 2004); the averaging time frame (February–May) for X2 coincides with the primary spawning and upstream rearing period for splittail; the availability of floodplain habitat, as indexed by Yolo Bypass stage, is directly related to X2 during February–May ($y = 4.38 - 2.21x$; $p<0.001$; $r^2 = 0.97$); the center of age-0 splittail distribution does not reach the estuary until summer (Feyrer et al. 2005); and the splittail X2-abundance relationship has not been affected by dramatic food web changes (Kimmerer 2002a) that have significantly altered the diet of young splittail in the estuary. (Feyrer et al. 2003.)

Population Abundance Goal

The immediate goal is to stabilize the Sacramento Splittail population, as measured by the FMWT index, and to begin to grow the population. The long-term goal is to maintain population abundance index as measured by FMWT in half of all years above the long term population index value.

Species- Specific Recommendations

Delta Outflow - Upstream covariates of X2, such as the availability of suitable floodplain and off-channel spawning and nursery habitat, appear to be the attributes supporting the flow-abundance relationship for splittail. Therefore, the flow needs of this species, with respect to spawning and rearing habitat, are most effectively dealt with through establishment of flow criteria that address the timing, duration, and magnitude of floodplain inundation from a river inflow standpoint.

Delta Inflow - Information in the record on conditions conducive to successful spawning and recruitment of splittail shows that the species depends on inundation of off-channel areas. Sufficient flows are therefore needed to maintain continuous inundation for at least 30 consecutive days in the Yolo Bypass, once floodplain inundation has been achieved based on runoff and discharge for ten days between late-February and May, during above normal and wet years (Table 12). (DFG closing comments, p. 7.)

Opportunities to provide floodplain inundation in other locations (e.g., the San Joaquin River) warrant further examination.

Feyrer *et al* (2006a) noted that manipulating flows entering Yolo Bypass such that floodplain inundation is maximized during January through June will likely provide the greatest overall benefit for splittail, especially in relatively dry years when overall production is lowest. Within the Yolo Bypass, floodplain inundation of at least a month appears to be necessary for a strong year class of splittail (Sommer *et al*. 1997); however, abundance was highest when the period of inundation extended 50 days or more. (Meng and Moyle 1995.) Floodplain inundation during the months of March, April, and May appears to be most important. (Wang 1986, Moyle 2002.) Managing the frequency and duration of floodplain inundation during the winter and spring, followed by complete drainage by the end of the flooding season, could favor splittail and other native fish over non-natives. (Moyle et al. 2007, Grimaldo et al. 2004.) Duration and timing of inundation are important factors that influence ecological benefits of floodplains.

Yolo Bypass Inundation – The Fremont Weir is a passive facility that begins to spill into the Yolo Bypass when the Sacramento River flow at Verona exceeds 55,000 to 56,000 cfs. (AR/NHI 1, p. 21; EDF 1, p. 50; TBI/NRDC 3, p. 35; Sommer et al. 2001b.) Water also enters the bypass at the Sacramento Weir and from the west via high flow events in small west-side tributaries. (Feyrer et al. 2006b.) Each of these sources joins the Toe Drain, a perennial channel along the east side of the Yolo Bypass floodplain, and water spills onto the floodplain when the Toe Drain flow exceeds approximately 3,500 cfs. (Feyrer et al. 2006b.) The Yolo Bypass typically floods in winter and spring in about 60% of years (DOI 1, p. 54; Sommer et al. 2001a; Feyrer et al. 2006a), with inundation occurring as early as October and as late as June, with typical peak period of inundation during January-March. (Sommer et al. 2001b.) In addition, studies suggest phytoplankton, zooplankton, and other organic material transported from the Yolo Bypass enhances the food web of the San Francisco Estuary. (Jassby and Cloern 2000; Mueller-Solger et al. 2002; Sommer et al. 2004.) Much of the water diverted into the bypass drains back into the north Delta near Rio Vista. Besides the Yolo Bypass, the only other Delta region with substantial connectivity to portions of the historical floodplain is the Cosumnes River, a small undammed watershed. (Sommer et al. 2001b.)

Multiple participants provided recommendations concerning the magnitude and duration of floodplain inundation along the Sacramento River, lower San Joaquin River, and within the Yolo and Sutter bypasses. (AR/NHI 1, p. 32; DFG closing comments; DOI 1, p. 54, EDF 1, pp. 50-52, 53-55; SFWC closing comments; TBI/NRDC 3, p. 36.) In addition, the draft recovery plan for the Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley Steelhead (NMFS 2009) calls for the creation of annual spring inundation of at least 8,000 cfs to fully activate the Yolo Bypass floodplain. (NMFS 5, p.157.)

Overtopping the existing weirs and flooding the bypasses (e.g., Yolo and Sutter) to achieve prolonged periods (30 to 60 days) of floodplain inundation in below normal and dry water years would require excessive amounts flows given the typical runoff patterns during those year types. (AR/NHI 1, p. 29.) From a practical standpoint, it is probably only realistic to achieve prolonged inundation during drier water year types by notching the upstream weirs and possibly implementing other modifications to the existing system. (AR/NHI 1, p. 29.)

The BDCP is currently evaluating structural modifications to the Fremont Weir (e.g., notch the weir and install operable "inundation gates"), as a means of increasing the interannual frequency and duration of floodplain inundation in the Yolo Bypass. (BDCP 2009.) TBI/NRDC (TBI/NRDC 3, p. 36) and AR/NHI (AR/NHI 1, p. 32) provided floodplain inundation recommendations for the Yolo Bypass assuming structural modifications to the Fremont Weir were implemented. A potential negative impact of notching the Fremont Weir is that it will affect stage height and Sutter Bypass flooding, and the resulting spawning and rearing of splittail and spring-run Chinook salmon. (personal communication R. Baxter.)

The NMFS Opinion stipulates that USBR and DWR, in cooperation with DFG, USFWS, NMFS, and USACE, shall, to the maximum extent of their authorities (excluding condemnation authority), provide significantly increased acreage of seasonal floodplain rearing habitat, with biologically appropriate durations and magnitudes, from December through April, in the lower Sacramento River basin, on a return rate of approximately one to three years, depending on water year type. (NMFS 3, p.608.) USBR and DWR are to submit a plan to implement this action to NMFS by December 31, 2011. (NMFS 3, p. 608.) This plan is to include an evaluation of options to, among other things, increase inundation of publicly and privately owned suitable acreage within the Yolo Bypass and modify operations of the Sacramento Weir or Fremont Weir to increase rearing habitat. (NMFS 3, p. 608.) The NMFS Opinion specifies that in the event that this action conflicts with Shasta Operations Actions I.2.1 to I.2.3 (e.g., carryover storage requirements), the Shasta Operations Actions shall prevail. (NMFS 3, p. 608.)

OMR Flows - Entrainment of splittail at the SWP and CVP export facilities is highest during adult spawning migrations and periods of peak juvenile abundance in the Delta. (Meng and Moyle 1995, Sommer et al. 1997.) The incidence of age-0 splittail entrainment increased during wet years when abundance was also high (Sommer et al. 1997.) However, analyses conducted by Sommer et al. (1997) suggested that entrainment at the export facilities did not have an important population-level effect. However, Sommer et al. (1997) noted that their evidence does not demonstrate that entrainment never affects the species. For example, if the core of the population's distribution were to shift toward the south Delta export facilities during a dry year, there could be substantial entrainment effects to a year-class. (Sommer et al. 1997.) Criteria for net OMR flows intended to protect salmon, delta smelt, and longfin smelt populations, as well as restrictions stipulated in the Opinions (NMFS 3, pp. 648-653; USFWS 2008) are likely to reduce the number of splittail entrained at the export facilities.

Table 12. Floodplain Inundation Criteria for Sacramento Splittail

Mechanism	Water Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Spawning and Rearing Habitat	AN / W	--	≥ 30 day floodplain inundation				--	--	--	--	--	--	--

Starry Flounder (*Platichthys stellatus*)

Status

Starry flounder is not listed pursuant to either the ESA or CESA.

Life History

Starry flounder is a native to the Bay-Delta Estuary. The geographic distribution of flounder is from Santa Barbara, California, to Alaska and in the western Pacific as far south as the Sea of Japan. (Miller and Lea 1972.) Starry flounder are important in both the recreational and commercial catch in both central and northern California. (Haugen 1992; Karpov et al. 1995.)

Starry flounder is an estuarine dependent species. (Emmett et al. 1991.) Spawning occurs in the Pacific Ocean near the entrance to estuaries and other freshwater sources between November and February. (Orcutt 1950.) Juveniles migrate from marine to fresh water between March and June and remain through at least their second year of life before returning to the ocean. (Baxter 1999.) Young individuals are found in Suisun Bay and Marsh and in the Delta. Older individuals range from Suisun to San Pablo bays. Maturity is reached by males at the end of their second year and by females in their third or fourth years. (Orcott 1950.)

Population abundance of young of the year and one year old starry flounder have been measured by the San Francisco Otter Trawl Study since 1980 and reported as an annual index. (Kimmerer et al. 2009.) The index declined between 2000 and 2002 but has since recovered to values in the 300 to 500 range. The median index value for the 29 years of record is 293.

Population Abundance Relationship to Flow

Starry flounder age-1 abundance in the San Francisco Bay otter trawl study is positively correlated with the March through June outflow of the previous year. (Kimmerer et al. 2009.) The mechanism underlying the abundance outflow relationship is not known but may be increased passive transport of juvenile flounder by strong bottom currents during high outflow years. (Moyle 2002.) There has been a decline in the abundance of flounder for any given outflow volume since 1987, presumably because of the invasion by the clam Corbula, however, the overall abundance-flow relationship is still statistically significant. (Kimmerer 2002a.)

Population Abundance Goal

The goal is to maintain the starry flounder population abundance index, as measured by the San Francisco Otter Trawl Study, in half of all years above the long term population median index value of 293.

Species-Specific Recommendations

Outflow recommendations were only received from the DFG. (DFG 1, p. 16.) DFG recommends maintaining X2 between 65 and 74 km between February and June. This corresponds to an average outflow of 11,400 to 26,815 cfs. Table 13 contains the criteria needed for protection of starry flounder. The purpose of this outflow criteria is to

maintain population abundance near the long term median index value of 293. This net Delta outflow criteria is similar to those proposed for the protection of longfin smelt, delta smelt, and *Crangon sp*. The State Water Board's criteria for Delta outflow for the protection of both longfin and delta smelt and *Crangon* will also protect starry flounder. The proposed outflow is consistent with DFG's recommendation for starry flounder. There is no information in the record to support criteria for inflows or hydrodynamics to protect starry flounder.

Table 13. Criteria for Delta Outflow to Protect Starry Flounder

Flow Type	Water Year Type	Jan	Feb	Mar	April	May	Jun
Net Delta Outflow	C	14,000 – 21,000			10,000 – 17,500		
	D	21,000 – 35,200			17,500 – 29,000		
	BN	35,200 – >50,000			29,000 – 42,000		
	AN	>50,000			>42,000		
	W	>50,000			>42,000		

California Bay Shrimp (*Crangon franciscorum*)

Status

The California bay shrimp is not listed pursuant to either ESA or CESA.

Life History

There are three native species of Crangon, collectively known as bay shrimp or grass shrimp, common to the San Francisco Estuary: *Crangon franciscorum, C. nigricauda*, and *C. nigromaculata.* (Hieb 1999.) Bay shrimp are fished commercially in the lower estuary and sold as bait. (Reilly et al. 2001.) *C. franciscorum* species is targeted by the commercial fishery because of its larger size. Bay shrimp are also important prey organisms for many fish in the estuary. (Hatfield, 1995.)

The California bay shrimp (*Crangon franciscorum*) is an estuary dependent species that is distributed along the west coast of North America from Alaska to San Diego. Larvae hatch from eggs carried by females in winter in the lower estuary or offshore in the Pacific Ocean. Most late-stage larvae and juvenile *C. franciscorum* migrate into the estuary and upstream to nursery areas between April and June. Juvenile shrimp are common in San Pablo and Suisun bays in high outflow years. Their center of distribution moves upstream to Honker Bay and the lower Sacramento and San Joaquin rivers during low flow years. (Hieb 1999.) Mature shrimp migrate back down to higher salinity waters after a four to six month residence in the upper estuary. (Hatfield 1985.) *C. franciscornum* mature at one year and may live up to two years. Some females hatch more than one brood of eggs during a breeding season.

Population abundance of juvenile *C. franiscorum* is measured by DFG's San Francisco Bay Study and is reported as an annual index. (Jassby et al. 1995, Hieb 1999.) Indices over the 29 years of record have varied from 31 to 588 with a median value of about 103.

Population Abundance and Relationship to Flow

There is a positive correlation between the abundance of *C. franciscorum* and net Delta outflow from March to May of the same year. (Jassby et al. 1995; Kimmerer et al. 2009.) The statistical relationship has remained constant since the early years of the San Francisco Bay Study, which began in 1980. The mechanism underlying the abundance relationship is not known but may be an increase in the passive transport of juvenile shrimp up-estuary by strong bottom currents during high outflows years. (Kimmerer et al. 2009, Moyle 2002, DFG 1992.) Other potential mechanisms include the effects of freshwater outflow on the amount and location of habitat, the abundance of food organisms and predators, and the timing of the downstream movement of mature shrimp. (DFG 1, p. 23.)

Delta outflow recommendations (Table 14) were received from both the DFG (DFG 1, p. 23) and TBI/NRDC. (TBI/NRDC 2, p. 17). TBI/NRDC analyzed the productivity of *C. franciscorum* as a function of net Delta outflow between March and May. The analysis suggests that estuary populations increased in about half of all years when flows between March and May were approximately 5 million acre-feet (MAF), or about 28,000 cfs per month. TBI/NRDC recommended that flow be maintained in most years above 28,000 cfs during these three months to insure population growth about half the time. The DFG recommended a net Delta outflow criterion of 11,400 to 26,800 cfs between February and June of all water years to aid immigration of late stage larvae and small juveniles.

Table 14. Participant Recommendations for Delta Outflows to Protect Bay Shrimp

	Water Year	**Feb**	**Mar**	**Apr**	**May**	**Jun**
TBI/NRDC Exhibit 2	Most years		28,000			
Fish and Game Exhibit 1	all	11,400 to 26,815				

Population Abundance Goal

The goal is to maintain the juvenile C*. franciscorum* population abundance index, as measured by the San Francisco Bay Study otter trawl, in half of all years above a target value of 103. An index of 103 is the median longterm index value for this species in the San Francisco Estuary.

Species-Specific Recommendations

The State Water Board determines the Delta outflow criteria in Table 15 are needed to protect C*rangon franciscorum*. The purpose of the outflow criteria is to maintain population abundance at a long term median index value of 103. Positive population growth is expected in half of all years under these flow conditions. The Delta outflow criteria are similar to those proposed for protection of both longfin smelt and delta smelt. The nursery area for C*. franciscorum* is usually downstream of the influence of the pumps, therefore no OMR flow recommendations were received and no review was conducted.

Table 15. Criteria for Delta Outflows to Protect Bay Shrimp

Flow Type	Water Year Type	Jan	Feb	Mar	April	May
Net Delta Outflow	C	14,000 – 21,000			10,000 – 17,500	
	D	21,000 – 35,200			17,500 – 29,000	
	BN	35,200 – >50,000			29,000 – 42,000	
	AN	>50,000			>42,000	
	W	>50,000			>42,000	

Zooplankton (*E. affinis* and *N. mercedis*)

Status

Eurytemora affinis is a non-native species that is not listed pursuant to either the ESA or CESA. *Neomysis mercedis* is a native species that is not listed pursuant to either the ESA or CESA.

Life History[14]

Zooplankton is a general term for small aquatic animals that constitute an essential food source for fish, especially young fish and all stages of pelagic fishes that mature at a small size, such as longfin smelt and delta smelt (DFG 1987b). Although DFG follows trends of numerous zooplankton taxa (e.g., Hennessy 2009), two upper estuary zooplankton taxa of particular importance to pelagic fishes have exhibited abundance relationships to Delta outflow. The first is the mysid shrimp *Neomysis mercedis*, which before its decline, beginning in the late 1980s, was an important food of most small fishes in the upper estuary (see Feyrer et al. 2003). Prior to 1988, *N. mercedis* mean summer abundance (June through October) increased significantly as X2 moved downstream (mean March through November location, Kimmerer 2002a. Table 1). After 1987, *N. mercedis* abundance declined rapidly and is currently barely detectable (Kimmerer 2002a, Hennessy 2009). The second is a calanoid copepod, *Eurytemora affinis*, which also declined sharply after 1987, but more so in summer than in spring (Kimmerer 2002a). Before 1987, *E. affinis* was abundant in the low salinity habitat (0.8-6.3 ‰) throughout the estuary (Orsi and Mecum 1986). *E. affinis* is an important food for most small fishes, particularly those with winter and early spring larvae, such as longfin smelt, delta smelt and striped bass (Lott 1998, Nobriga 2002, Bryant and Arnold 2007, DFG unpublished).

Population Abundance and Relationship to Flow

E. affinis was historically abundant throughout the year, particularly in spring and summer, but after 1987 abundance declined in all seasons, most notably in summer and fall. (Hennessy 2009, as cited in DFG 1, p. 26.) After 1987, *E. affinis* spring abundance (March through May) has significantly increased as spring X2 has moved downstream. (Kimmerer 2002a. Table 1, as cited in DFG 1, p. 26.) Relative abundance in recent years is highest in spring and persistence of abundance is related to spring outflow. As flows decrease in late spring, abundance decreases to extremely low levels throughout the estuary. (Hennessey 2009, as cited in DFG 1, p. 26.)

[14] This section was largely extracted from DFG Exhibit 1, page 25.

The only outflow recommendation identified in the record specifically for *E. affinis* and *N. mercedis* was submitted by DFG, in their closing comments (Table 16). According to DFG, their current science-based conceptual model is that placement of X2 in Suisun Bay represents the best interaction of water quality and landscape for fisheries production given the current estuary geometry. (DFG 2, p. 6.) Maintaining X2 at 75 km and 64 km corresponds to net Delta outflows of approximately 11,400 cfs and 29,200 cfs, respectively. The Bay Institute provided flow recommendations for a suite of species, including *E. affinis (*Table 17*).*

Table 16. DFG's Delta Outflow Recommendation to Protect *E. affinis* and *N. mercedis* (DFG Closing Comments)

Species	Parameter	Effect or Mechanism	Timing	Minimum	Maximum	Reference
Zooplankton	Flows	Habitat	February - June	X2 at 75 km	X2 at 64 km	DFG Exhibit 1, p.25-26; Exhibit 2, p.6

Table 17. The Bay Institute's Delta Outflow Recommendations to Protect Zooplankton Species Including *E. affinis*

Species	Mechanism	Water Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Eurytemora affinis	Habitat	81-100% (driest years)	14000-21000 cfs		10000-17500 cfs			3000-4200 cfs						
		61-80%	21000-35000 cfs		17500-29000 cfs			4200-5000 cfs						
		41-60%	35200-55000 cfs		29000-42500 cfs			5000-8500 cfs						
		21-40%	55000-87500 cfs		42500-62500 cfs			8500-25000 cfs						
		0-20% (wettest years)	87500-140000 cfs		62500-110000 cfs			25000 - 50000 cfs						

Species-Specific Recommendations

Table 18 shows the State Water Board's determination for Delta outflows needed to protect zooplankton. These recommendations are consistent with those submitted by DFG. (closing comments, p. 7.) The State Water Board concurs with DFG's current science-based conceptual model which concludes that placement of X2 in Suisun Bay represents the best interaction of water quality and landscape for fisheries production given the current estuary geometry. (DFG 2, p. 6.) Maintaining X2 at 75 km and 64 km corresponds to net Delta outflows of approximately 11,400 cfs and 29,200 cfs,

respectively. No explicit recommendations concerning zooplankton and inflow or hydrodynamic requirements were identified in the record.

Table 18. Criteria for Delta Outflows to Protect Zooplankton

Effect or Mechanism	Water Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Habitat	All	--	X2[1] – 75 to 64 km (~11400 – 29200 cfs)					--	--	--	--	--	--

4.3 Other Measures

Information in the record for this proceeding broadly supports the five key points submitted by the DEFG of experts (DEFG 1):

1) Environmental flows are more than just volumes of inflows and outflows
2) Recent flow regimes both harm native species and encourage non-native species
3) Flow is a major determinant of habitat and transport
4) Recent Delta environmental flows are insufficient to support native Delta fishes for today's habitats
5) A strong science program and a flexible management regime are essential to improving flow criteria

These key points recognize that although adequate environmental flows are a necessary element to protect public trust resources in the Delta ecosystem, flows alone are not sufficient to provide this protection. These key points and other information in the record warrant a brief summary discussion of other information in the record that should be considered in the development of flow criteria, consistent with the charge of SB1 that "the flow criteria include the volume, quality, and timing of water necessary for the Delta ecosystem. " Based on review of the information in the record this charge is expanded to include specific consideration of:

- Variability, flow paths, and the hydrograph
- Floodplain activation and other habitat improvements
- Water quality and contaminants
- Cold water pool management
- Adaptive management

4.3.1 Variability, Flow Paths, and the Hydrograph

The first of the five key points submitted by the DEFG of experts stated, in part: "There is no one correct flow number. Seasonal, interannual, and spatial variability, to which our native species are adapted, are as important as quantity." Species and biological systems respond to combinations of quantity, timing, duration, frequency and how these inputs vary spatially. (DEFG 1.) Based on their review of the literature in *Habitat Variability and Complexity in the Upper San Francisco Estuary*, Moyle *et al* (2010) find:

> " unmodified estuaries are highly variable and complex systems, renowned for their high production of fish and other organisms (McClusky and Elliott 2004). The San Francisco Estuary, however, is one of the most highly modified and controlled estuaries in the world (Nichols et al. 1986). As a consequence, the

estuarine ecosystem has lost much of its former variability and complexity and has recently suffered major declines of many of its fish resources (Sommer et al. 2007).

the concept of the "natural flow regime" (Poff et al. 1997) is increasingly regarded as an important strategy for establishing flow regimes to benefit native species in regulated rivers (Postel and Richter 2003; Poff et al. 2007; Moyle and Mount 2007). For estuaries worldwide, the degree of environmental variability is regarded as fundamental in regulating biotic assemblages (McLusky and Elliott 2004). Many studies have shown that estuarine biotic assemblages are generally regulated by a combination of somewhat predictable changes (e.g., tidal cycles, seasonal freshwater inflows) and stochastic factors, such as recruitment variability and large-scale episodes of flood or drought (e.g., Thiel and Potter 2001). The persistence and resilience of estuarine assemblages is further decreased by various human alterations, ranging from diking of wetlands, to regulation of inflows, to invasions of alien species (McLusky and Elliott 2004, Peterson 2003).

a key to returning the estuary to a state that supports more of the desirable organisms (e.g., Chinook salmon, striped bass, delta smelt) is increasing variability in physical habitat, tidal and riverine flows, and water chemistry, especially salinity, over multiple scales of time and space. It is also important that the stationary physical habitat be associated with the right physical-chemical conditions in the water at times when the fish can use the habitat most effectively (Peterson 2003)."

An example of a major change in the natural flow regime of the Delta is demonstrated by the increase in net OMR reverse flows just north of the SWP and CVP pumping facilities. Reverse flows are now a regular occurrence in the Delta channels because Sacramento River water enters on the northern side of the Delta while the two major pumping facilities, the SWP and CVP, are located in the south. This results in a net water movement across the Delta in a north-south direction along a web of channels including OMR instead of the more natural pattern from east to west or from land to sea. Positive net flows, connected flow paths, and salinity gradients are important features of an estuary. Natural net channel flows move water and some biota toward Suisun Bay and maintain downstream directed salinity gradients. Today, Delta gates and diversions can substantially redirect tidal flows creating net flow patterns and salinity and turbidity distributions that did not occur historically. These changes may influence migratory cues for some fishes. These cues are further scrambled by a reverse salinity gradient in the south Delta caused by higher salinity in agricultural runoff. (DEFG 1.)

Per the DEFG's paper, *Habitat Variability and Complexity in the Upper San Francisco Estuary* (Moyle et al., 2010), a more variable Delta has multiple benefits:

"Achieving a variable, more complex estuary requires establishing seaward gradients in salinity and other water quality variables, diverse habitats throughout the estuary, more floodplain habitat along inflowing rivers, and improved water quality. These goals in turn encourage policies which: (1) establish internal Delta flows that create a tidally-mixed, upstream-downstream gradient (without cross-Delta flows) in water quality; (2) create slough networks with more natural channel

> geometry and less diked rip-rapped channel habitat; (3) improve flows from the Sacramento and San Joaquin rivers; (4) increase tidal marsh habitat, including shallow (1-2 m) subtidal areas, in both fresh and brackish zones of the estuary; (5) create/allow large expanses of low salinity (1-4 ppt) open water habitat in the Delta; (6) create a hydrodynamic regime where salinities in parts of the Delta and Suisun Bay and Marsh range from near-fresh to 8-10 ppt periodically (does not have to be annual) to discourage alien species and favor desirable species; (7) take species-specific actions that reduce abundance of non-native species and increase abundance of desirable species; (8) establish abundant annual floodplain habitat, with additional large areas that flood in less frequent wet years; (9) reduce inflow of agricultural and urban pollutants; and (10) improve the temperature regime in large areas of the estuary so temperatures rarely exceed 20°C during summer and fall months."

Similarly, reliance upon water year classification as a trigger for flow volumes has contributed to reduced flow variability in the estuary. The information received during this proceeding supports the notion that reliance upon water year classification as a trigger for flow volumes is an imperfect means of varying flows. Any individual month or season might have a dramatically different hydrology than the overall hydrology for the year. A critically dry year, for example, can have one or two very wet months, just as a wet year may have several disproportionately dry months. Figure 10 demonstrates how this actually occurs. Unimpaired Delta outflow for the month of June from 1922 through 2003 has historically been highly variable. Many June months that occur in years classified as wet have had much lower flows than June flows in years classified as below normal. The opposite is also true; several June flows in years classified as critically dry are higher than some years classified as above normal. Depending on the direction of this divergence of monthly flows (higher or lower) relative to the water year, reliance upon water year classification can provide less than optimal protection of the ecosystem or more than needed water supply impacts. The figure also shows the actual June flows for various periods of years, demonstrating how much lower actual flows have been than unimpaired flows. The primary reason for the lower historical flows is consumption of water in the watershed. The three periods shown, however, are not directly comparable to the unimpaired flow record because the shorter time frame may have been wetter or drier than the full historical record.

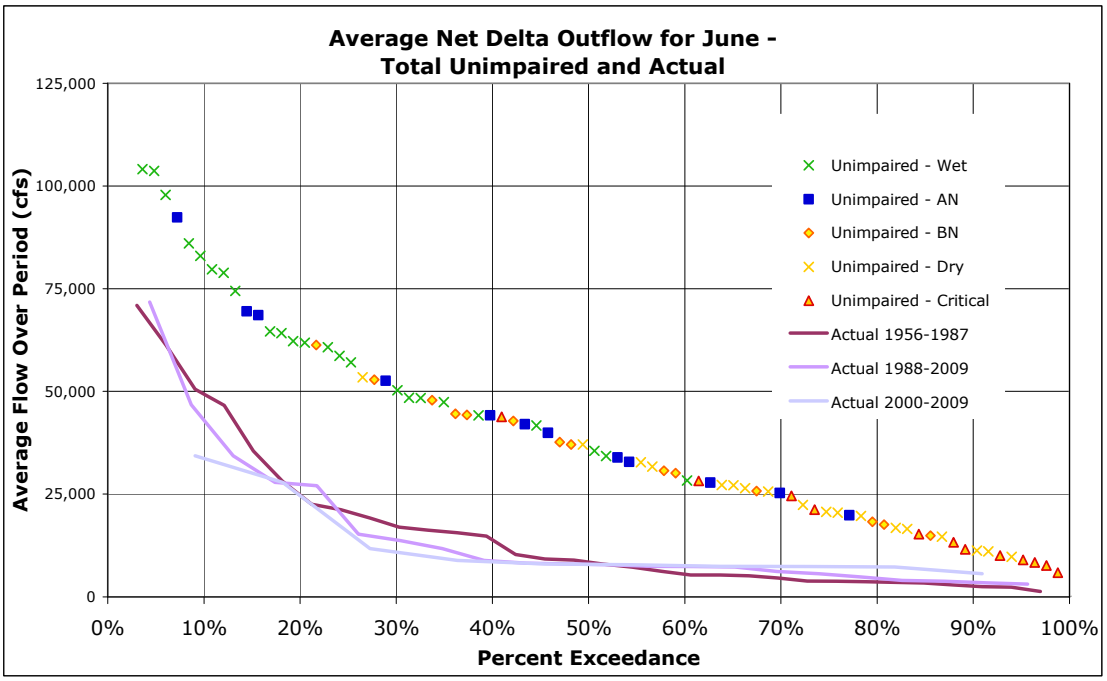


Figure 10. Actual and Unimpaired June Delta Outflow

Proportionality is one of the key attributes of restoring ecosystem functions by mimicking the natural hydrograph in tributaries to the Delta and providing for connectivity. Currently, inflows to the Delta are largely controlled by upstream water withdrawals and releases for water supply, power production, and flood control. As a result, inflows from tributaries frequently do not contribute flow to the Delta in the same proportions as they would have naturally, and to which native fish adapted. There is consensus in contemporary science that improving ecosystem function in the watershed, mainstem rivers, and the Delta is a means to improving productivity of migratory species. (e.g.,Williams 2005; NRC 1996, 2004a, 2004b as cited in NAS 2010, p. 42.) NAS found that, "Watershed actions would be pointless if mainstem passage conditions connecting the tributaries to, and through, the Delta were not made satisfactory." (NAS 2010, p. 42.) "Propst and Gido (2004) support this hypothesis and suggest that manipulating spring discharge to mimic a natural flow regime enhances native fish recruitment (Propst and Gido, 2004 and Marchetti and Moyle, 2001)." (DOI, 1 p. 25.) Specifically, providing pulse flows to mimic the natural hydrograph could diversify ocean entry size and timing for anadromous fishes so that in many years at least some portion of the fish arrive in saltwater during periods favoring rapid growth and survival. (DOI 1, p. 30.) Food production may also be improved by maintaining the attributes of a natural hydrograph (EFG 1, p. 8.) Connectivity between natal streams and the Delta is critical for anadromous species that require sufficient flows to emigrate out of natal streams to the Delta and ocean, and sufficient flows upon returning, including flows necessary to achieve homing fidelity. Specifically, it is necessary for the scent of the river to enter the Bay in order for adult salmonids to find their way back to their natal river. (NMFS 2009, p.407 as cited in EDF 1, p. 48.) Further, insuring adequate flows from all of the tributaries that support native fish is important to maintain genetic diversity and species resilience in the face of catastrophic events.

4.3.2 Floodplain Activation and Other Habitat Improvements

Most floodplains in the Central Valley have been isolated from their rivers by levees. Due to the effects of levees and dams, side channel and floodplain inundating flows have been substantially reduced. At present, besides the Yolo Bypass, the only other Delta region with substantial connectivity to portions of the historical floodplain is the Cosumnes River, a small undammed watershed. (Sommer et al. 2001b.) Floodplains are capable of providing substantial benefits to numerous aquatic, terrestrial, and wetland species. (Sommer et al. 2001b.) Inundation of floodplains facilitates an exchange of organisms, nutrients, sediment, and organic material between the river and floodplain, and provides a medium in which biogeochemical processes and biotic activity (e.g., phytoplankton blooms, zooplankton and invertebrate growth and reproduction) can occur. (AR/NHI 1, p. 22.) This exchange of material can benefit downstream areas. For example, studies suggest phytoplankton, zooplankton, and other organic material transported from the Yolo Bypass enhances the food web of the San Francisco Estuary. (Jassby and Cloern 2000; Mueller-Solger et al. 2002; Sommer et al. 2004.)

Many fishes rear opportunistically on floodplains. (Moyle et al. 2007, as cited in Moyle et al. 2010), and juvenile salmon grow faster and become larger on floodplains than in the main-stem river channels. (Sommer et al. 2001a; Jeffres et al. 2008; DOI 1, p. 27; AR/NHI 1, p. 24.) Splittail require floodplains for spawning (Moyle et al. 2007), with large-scale juvenile recruitment occurring only in years with significant protracted (greater than or equal to 30 days) floodplain inundation, particularly in the Sutter and Yolo bypasses. (Meng and Moyle 1995, Sommer et al. 1997, Feyrer et al. 2006a.) Managing the frequency and duration of floodplain inundation during the winter and spring, followed by complete drainage by the end of the flooding season, could favor splittail and other native fish over non-natives. (Moyle et al. 2007, Grimaldo et al. 2004.) In addition, modeling conducted by Moyle et al. (2004) shows that while splittail are resilient, managing floodplains to promote frequent successful spawning is needed to keep them abundant. Improving management of the Yolo Bypass for fish, increasing floodplain areas along other rivers (e.g., Cosumnes and Mokelumne rivers), and developing floodplain habitat along the lower San Joaquin River, including a bypass in the Delta, represent opportunities to increase the frequency and extent of floodplain inundation. (Moyle et al. 2010.) The BDCP is currently evaluating structural modifications to the Fremont Weir (e.g., notch weir and install operable “inundation gates”), as a means of increasing the interannual frequency and duration of floodplain inundation in the Yolo Bypass. (BDCP 2009.)

The NMFS Opinion stipulates that USBR and DWR, in cooperation with DFG, USFWS, NMFS, and USACE, shall, to the maximum extent of their authorities (excluding condemnation authority), provide significantly increased acreage of seasonal floodplain rearing habitat, with biologically appropriate durations and magnitudes, from December through April, in the lower Sacramento River basin, on a return rate of approximately one to three years, depending on water year type. (NMFS 3, p. 608.) Per this NMFS Opinion, USBR and DWR are to submit a plan to implement this action to NMFS by December 31, 2011. (Id.) This plan is to include an evaluation of options to, among other things, increase inundation of publicly and privately owned suitable acreage within the Yolo Bypass, and modify operations of the Sacramento Weir or Fremont Weir to increase rearing habitat. (Id.)

Moyle et al. (2010) discuss the value of creating more slough networks with natural geometry and less diked, rip-rapped channel habitat, the value of tidal marsh habitat, and low salinity, open water habitat in the Delta:

> "Re-establishing the historical extensive dendritic sloughs and marshes is essential for re-establishing diverse habitats and gradients in salinity, depth and other environmental characteristics important to desirable fish and other organisms (e.g., Brown and May 2008). These shallow drainages are likely to increase overall estuarine productivity if they are near extensive areas of open water, because they can deliver nutrients and organic matter to the more open areas. Dendritic slough networks will develop naturally in Suisun Marsh after large areas become inundated following dike failures and they can be recreated fairly readily in the Cache Slough region by reconnecting existing networks. In the Delta, the present simplified habitat in the channels between islands needs to be made more suitable as habitat for desirable species. Many levees are maintained in a nearly vegetation-free state, providing little opportunity for complex habitat (e.g., marshes and fallen trees) to develop. Much of the low-value channel habitat in the western and central Delta will disappear as islands flood, but remaining levees in submerged areas should be managed to increase habitat complexity (e.g., through planting vegetation), especially in the cooler northern and eastern parts of the Delta.
>
> [Subtidal] habitat has been greatly depleted because marshes in the Delta and throughout the estuary have been diked and drained, mostly for farming and hunting (Figure 3). Unfortunately, most such habitat in shallow water today is dominated by alien fishes, including highly abundant species such as Mississippi silverside which are competitors with and predators on native fishes (Moyle and Bennett 1996; Brown 2003). Such habitat could become more favorable for native fishes with increased variability in water quality, especially salinity. In particular, increasing the amount of tidal and subtidal habitat in Suisun Marsh should favor native fishes, given the natural variability in salinity and temperature that occurs there. The few areas of the marsh with natural tidal channels tend to support the highest diversity of native fishes, as well as more striped bass (Matern et al. 2002; Moyle, unpublished data). With sea level rise, many diked areas of Suisun Marsh currently managed for waterfowl (mainly dabbling ducks and geese) will return to tidal marsh and will likely favor native fishes such as splittail and tule perch (Hysterocarpus traski), as well as (perhaps) migratory fishes such as juvenile Chinook salmon. Experimental (planned) conversions of some of these areas would be desirable for learning how to manage these inevitable changes to optimize habitat for desired fishes.
>
> Open water habitat is most likely to be created by the flooding of subsided islands in the Delta, as well as diked marshland 'islands' in Suisun Marsh (Lund et al. 2007, 2010; Moyle 2008). The depth and hydrodynamics of many of these islands when flooded should prevent establishment of alien aquatic plants while variable salinities in the western Delta should prevent establishment of dense populations of alien clams (Lund et al. 2007).

Although it is hard to predict the exact nature of these habitats, they are most likely to be better habitat for pelagic fishes than the rock-lined, steep-sided and often submerged vegetation-choked channels that run between islands today (Nobriga et al. 2005). Experiments with controlled flooding of islands should provide information to help to ensure that these changes will favor desired species. Controlled flooding also has the potential to allow for better management of hydrodynamics and other characteristics of flooded islands (through breach location and size) than would be possible with unplanned flooding."

4.3.3 Water Quality and Contaminants

Toxic effects are one of three general factors identified by scientists with the IEP in 2005 as contributing to the decline in pelagic productivity. The life history requirements and water quality sections above identify specific species sensitivities to water quality issues.

Though the information received in this proceeding supports the recommendation that modification to flow through the Delta is a necessary first step in improving the health of the ecosystem, it also supports the recommendation that flow alone is insufficient. The Delta and San Francisco Bay are listed under section 303(d) of the Federal Clean Water Act as impaired for a variety of toxic contaminants that may contribute to reduced population abundance of important fish and invertebrates. The contaminants include organophosphate and pyrethrin pesticides, mercury, selenium and unknown toxicity. In addition, low DO levels periodically develop in the San Joaquin River at the DWSC and in OMR. The low oxygen levels in the DWSC inhibit the upstream migration of adult fall-run Chinook salmon and adversely impact other resident aquatic organisms.

There is concern that a number of non-303(d) listed contaminants, such as ammonia, pharmaceuticals, endocrine disrupting compounds, and blue-green algal blooms could also limit biological productivity and impair beneficial uses. Sources of these contaminants include agricultural, municipal and industrial wastewater, urban storm water discharges, discharges from wetlands, and channel dredging activities. More work is needed to determine their impact on the aquatic community.

Ammonia has emerged as a contaminant of special concern in the Delta. Recent hypotheses are that ammonia is causing toxicity to delta smelt, other local fish, and zooplankton and is reducing primary production rates in the Sacramento River below the SRWTP and in Suisun Bay. A newer hypothesis is that ammonia and nitrogen to phosphorus ratios have altered phytoplankton species composition and these changes have had a detrimental effect on zooplankton and fish population abundance. (Glibert 2010.) More experiments are needed to evaluate the effect of nutrients, including ammonia, on primary production and species composition in the Sacramento River and Delta.

4.3.4 Cold Water Pool Management

As mentioned in the specific flow criteria, the criteria contained in this report should be tempered by the additional need to maintain cold water resources in reservoirs on tributaries to the Delta until improved passage and other measures are taken that would reduce the need for maintaining cold water reserves in reservoirs. As discussed in the Chinook salmon section, salmon have specific temperature tolerances during various portions of their life-cycle. Historically salmonids were able to take advantage of cooler

upstream temperatures for parts of their life-cycle to avoid adverse temperature effects. Since construction of the various dams in the Central Valley, access to much of the cooler historic spawning and rearing habitat has been blocked. To mitigate for these impacts, reservoirs must be managed to preserve cold water resources for release during salmonid spawning and rearing periods. As reservoir levels drop, availability of cold water resources also diminishes. Accordingly, it may not be possible to attain all of the identified flow criteria in all years and meet the thermal needs of the various runs of Chinook salmon and other sensitive species. Thorough temperature and water supply modeling analyses should be conducted to adaptively manage any application of these flow criteria to suit real world conditions and to best manage the competing demands for water needed for the protection of public trust resources, especially in the face of future climate change.

Specifically, these criteria should not be construed as contradicting existing and future cold water management requirements that may be needed for the protection of public trust resources, including those for the Sacramento River needed to protect the only remaining population of winter-run Chinook salmon. (see NMFS 3, p. 590-603.)

4.3.5 Adaptive Management

Any environmental flow prescription for native species in the Delta will be imperfect. The problem is too complex, uncertainties are too large, and the situation in the Delta is changing too rapidly in too many ways for any single flow prescription to be correct, or correct for long. (Fleenor et al. 2010.) Some degree of certainty regarding future conditions in the Delta is needed before long term flow criteria can be developed. Since it is unlikely that certainty will be achieved before actions or responses are required by geologic, biological, and legal processes, it might be valuable to provide substantial financial and water reserve resources, along with responsible institutional wherewithal to respond to changes and undertake necessary experiments for more successfully transitioning into the largely unexplored new Delta. (Fleenor et al. 2010.) This confounding need for certainty of operations and water supply at the same time there is uncertainty underlying ecosystem needs, provides good rationale to rely upon adaptive management to address this uncertainty.

The Delta is continually changing. Flow criteria developed for the present Delta ecosystem will become less reflective of ecosystem needs with the passage of time. Accordingly, it is important that flow criteria be adaptive to future changes. Flows, habitat restoration, and measures to address other stressors should be managed adaptively. (AR/NHI Closing Comments.)

Adaptive management is “an iterative process, based on a scientific paradigm that treats management actions as experiments subject to modification, rather than as fixed and final rulings, and uses them to develop an enhanced scientific understanding about whether or not and how the ecosystem responds to specific management actions.” (NRC 1999 as cited in DOI Ex.1.) This notion of treating actions as experiments is key, because information received in this proceeding indicates that the mechanisms underlying the relationship between flows and the health of the Delta ecosystem are, at times, unclear. Adaptive management is the most suitable approach for managing with uncertainty. (DEFG 1.)

Murray and Marmorek (2004) describe an adaptive management approach as:

- exploring alternative ways to meet management objectives
- predicting the outcomes of alternatives based on the current state of knowledge
- implementing one or more of these alternatives
- monitoring to learn about the impacts of management actions
- using the results to update knowledge and adjust management actions

An adaptive approach provides a framework for making good decisions in the face of critical uncertainties, and a formal process for reducing uncertainties so that management performance can be improved over time. (Williams et al. 2007.)

Adaptive management does not postpone action until "enough" is known but acknowledges that time and resources are too short to defer *some* action, particularly actions to address urgent problems. (Lee 1999.) Adaptive management provides a means of informing planning and management decisions in spite of uncertainty. Key point number 5 of the DEFG states: "a strong science program and a flexible management regime are essential to improving flow criteria. (DEFG 1.)

Adaptive management can be used to manage uncertainty in two ways, over two time frames. Over the short-term, adaptive management could allow for a specific response to real time conditions so long as the response is otherwise consistent with the constraints of some overarching regulatory framework. Over the longer term, adaptive management could allow for the more nimble modification of regulatory constraints, so long as these modifications fell within the clearly defined parameters of the overarching regulatory framework.

<u>Short-term Adaptive Management</u>
Per the DEFG's assessment regarding the role of uncertainty

> " despite [our] extensive scientific understanding substantial knowledge gaps remain about the ecosystem's likely response to flows. First, ecosystem processes in a turbid estuary are mostly invisible, and can be inferred only through sampling. Second, monitoring programs only scratch the surface of ecosystem function by estimating numbers of fish and other organisms, whereas the system's dynamics depend on birth, growth, movement, and death rates which can rarely be monitored. Third, this system is highly variable in space (vertical, cross-channel, along-channel, and larger-scale), time (tidal, seasonal, and interannual), flow, salinity, temperature, physical habitat type, and species composition. Each of the hundreds of species has a different role in the system, and these differences can be subtle but important. As a result, we have little ability to predict how the ecosystem will respond to the numerous anticipated deliberate and uncontrolled changes." (DEFG 1.)

Flexible management can be designed into a regulatory framework so that any requirements rely upon real time information and real time decisions to guide specific real-time action. A current example of this is the Delta Smelt Working Group that provides information and analyses used to guide real time operation of export facilities so that these facilities can be operated in a manner that conforms with the current NMFS

and USFWS opinions. Any such flexible management will need to consider the processes and governance structures required to make sound scienfically-based real-time decisions. The Delta Smelt Working Group is a good example of how scientific assessment of real-time data, including the presence of fish, can better inform the real-time operation of export facilities.

Long-term Adaptive Management

Over the longer term, adaptive management can be used to more nimbly modify regulatory constraints so that fishery and water resource agencies are not locked into prescriptive constraints well past the time that current scientific understanding can support. This longer term adaptive management has bearing on a number of the flow criteria being considered in this report because many of these criteria lack sufficiently robust information to support a specific numeric criterion. Although the functional basis for a beneficial flow may be understood, the basis for a specific numeric criteria may not. Some regulatory flows may therefore need to take the form of an informed experimental manipulation. Such flows would need to be implemented "as if they were experiments, with explicit conceptual and simulation models, predicting outcomes, and feedback loops so that the course of management and investigation can change as the system develops and knowledge is gained. A talented group of people tasked to integrate, synthesize, and recommend actions based on the data being gathered are essential for making such a system work. Failure to implement an effective adaptive management program will likely lead to a continued failure to learn from the actions, and a lack of responsiveness to changing conditions and increased understanding." (DEFG 1.)

The Delta Science Program, IEP, and other institutions could be relied upon to evaluate experimental flows and make recommendations to be considered for modifications of such flows.

4.4 Expression of Criteria as a Percentage of Unimpaired Flow

In some cases, participants' recommendations were expressed as specific flows in specific months, to be applied during specific water year types or with specified probabilities of exceedance. Review of unimpaired hydrology shows there is great variability in the quantity of unimpaired flow during these specified months when categorized by water year type. Reliance upon monthly or seasonal flow prescriptions based on water year type would therefore result in widely ranging relative amounts of unimpaired flow depending upon the specific hydrology of the month or season. Also, the rather coarse division of the hydrograph into five water year types can lead to abrupt step-wise changes in flow requirements. In an attempt to more closely reflect the variation of the natural hydrograph, the State Water Board recommends that, when possible, the flow criteria be expressed as a percentage of unimpaired flow.

To develop criteria in this way, the unimpaired flow rate for a specified time period (e.g. average monthly flow over a range of months) was plotted on an exceedance probability graph (using the Weibull plotting position formula) along with the flow recommendations and desired return frequencies. The unimpaired flow rates were also plotted such that the associated water year type can be identified and their percent exceedance estimated. A percentage of unimpaired flow was selected by trial and error so that the desired flow rate and exceedance frequency was achieved. A separate exceedance plot was produced for each time period being evaluated.

The unimpaired flow estimates used in the development of these flow criteria are based on those developed in the DWR May 2007 document: *"California Central Valley Unimpaired Flow Data" Fourth Edition Draft.* (DWR 2007.) This report contains estimates of the monthly flow for 24 sub-basins in the Central Valley. Each sub-basin uses a separate calculation dependant on conditions specific to that sub-basin, available gauge data, and relationships to other sub-basins. In many cases the methods change over the period of record to incorporate changes to infrastructure within the sub-basins that need to be accounted for. Estimates are provided for 83 water years from 1922 through 2003. A water year begins in October of the previous calendar year through September of the named water year. The following describes the unimpaired flow estimates that are the basis for flow criteria for the Sacramento River at Rio Vista, the San Joaquin River at Vernalis, and Net Delta Outflow.

Sacramento Valley Unimpaired Total Outflow

Estimates of the unimpaired Sacramento Valley outflow were computed as the sum of estimates from 11 sub-basins in the watershed and are understood to represent the flow that would occur on the Sacramento River at approximately Freeport. These 11 sub-basins include the Sacramento Valley Floor, Putah Creek near Winters, Cache Creek above Rumsey, Stony Creek at Black Butte, Sacramento Valley West Side Minor Streams, Sacramento River near Red Bluff, Sacramento Valley East Side Minor Streams, Feather River near Oroville, Yuba River at Smartville, Bear River near Wheatland, and the American River at Fair Oaks.

The unimpaired Sacramento Valley outflow from DWR 2007 is used as the basis for flow criteria on the Sacramento River at Rio Vista, even though it is understood they are more representative of unimpaired flows expected at Freeport. This is a necessary simplification as such estimates do not exist at Rio Vista, but should be adequate for the purpose of these criteria. If future flow requirements are to be established at Rio Vista based on a percentage of unimpaired flow, it is recommended that new estimates of unimpaired flow be developed specific for this location.

San Joaquin Valley Unimpaired Total Outflow

Estimates of the unimpaired San Joaquin Valley outflow were computed as the sum of estimates from nine sub-basins in the watershed and are understood to represent the flow that would occur on the San Joaquin River at Vernalis. These nine sub-basins include the Stanislaus River at Melones Reservoir, San Joaquin Valley Floor, Tuolumne River at Don Pedro Reservoir, Merced River at Exchequer Reservoir, Chowchilla River at Buchanan Reservoir, Fresno River near Daulton, San Joaquin River at Millerton Reservoir, Tulare Lake Basin Outflow, San Joaquin Valley West Side Minor Streams.

Delta Unimpaired Total Outflow

Estimates of unimpaired Net Delta Outflow in DWR 2007 were computed generally as Delta Unimpaired Total Inflow minus unimpaired net use in the Delta, including both lowlands and uplands. Delta Unimpaired Total Inflows was calculated as the sum of the Sacramento Valley and San Joaquin Valley Unimpaired Total Outflows as described above and the East Side Streams Unimpaired Total Outflow. The later consists of four sub-basins including San Joaquin Valley East Side Minor Streams, Cosumnes River at Michigan Bar, Mokelumne River at Pardee Reservoir, and Calaveras River at Jenny Lind. Generally the unimpaired net use in the Delta is an estimate of the consumptive

use from riparian and native vegetation (replacing historical irrigated agriculture and urban areas), plus evaporation from water surfaces, minus precipitation, and assumes that existing Delta levees and island remain intact. Unimpaired flow graphs in this report use the unimpaired flow record from 1922 to 2003.

5. Flow Criteria

Two types of criteria are provided in this report: numeric flow criteria, and other, non-numeric, measures that should be considered to complement the numeric criteria. Numeric criteria are subdivided into two categories: category "A" criteria have more and better scientific information, with less uncertainty, to support specific numeric criteria than do Category "B" criteria. Summary numeric criteria are provided for Delta outflow, as well as Sacramento River and San Joaquin River inflows, and Hydrodynamics (Old and Middle River, Inflow-Export Ratios, and Jersey Point flows) in Tables 19 through 22.

In addition to new criteria for Delta outflows, inflows, and hydrodynamics, some of the objectives for the protection of fish and wildlife from the 2006 Bay-Delta Plan are advanced as criteria in this report. While the State Water Board did not specifically reevaluate the methodology and basis for the Bay-Delta Plan objectives, the State Water Board recognizes that these flows provide some level of existing protection for fish and wildlife and, in the absence of more specific information, merit inclusion in these criteria. At the time the Bay-Delta Plan objectives were adopted, they were supported by substantial evidence, including scientific information. While the purpose of this report is to develop flow criteria using best available scientific information, water quality objectives are established taking into account scientific and other factors pursuant to Water Code section 1241.

5.1 Delta Outflows

Following are Delta outflow criteria based on analysis of the species-specific flow criteria and other measures:

1) Net Delta Outflow: 75% of 14-day average unimpaired flow for January through June
2) Fall X2 for September through November
   - Wet years X2 less than 74 km (greater than approximately 12,400 cfs)
   - Above normal years X2 less than 81 km (greater than approximately 7,000 cfs)
3) 2006 Bay-Delta Plan Delta Outflow Objectives for July through December

Delta outflow criteria 1 is a Category A criterion because it is supported by more robust scientific information. Delta outflow criteria 2 and 3 are Category B criteria because there is less scientific information to support specific numeric criteria, but there is enough information to support the conceptual need for flows. Category A and B criteria are both equally important for protection of the public trust resource, but there is more uncertainty about the appropriate volume of flow required to implement Category B criteria. Following is discussion and rationale for these criteria.

The narrative objective of the flow criteria is to halt the population decline and increase populations of native species as well as species of commercial and recreational importance. The need to estimate the magnitude, duration, timing, and quality of Delta outflows necessary to support viable populations of these species is inherent to this

objective. McElhany et al. (2000) proposed that four parameters are critical for evaluating population viability: abundance, population growth rate, population spatial structure, and diversity. Delta outflow may affect one, all, or some combination of these parameters for a number of resident and anadromous species. A species-specific analysis of flow needs for a suite of upper estuary species is included in section 4.2.4.

An analysis of generation to generation population abundance versus Delta outflows indicates that the "likelihood" of an increase in the longfin smelt FMWT abundance index in 50% of years corresponded with flow volumes of approximately 9.1 MAF (51,000 cfs) and 6.3 MAF (35,000 cfs) during January through March and March through May, respectively. (TBI/NRDC 2, pp. 17-19.) The provision of sufficient flows to achieve these flow volumes during January through March and March through May in approximately 45% and 47% of years, respectively, is intended to promote increased abundance and improved productivity for longfin smelt and other desirable estuarine species. Based on a comparison of the flows needs identified in section 4.2.4, it appears that winter-spring outflows designed to be protective of longfin smelt would benefit the other upper estuary species evaluated. The DFG recommended that spring outflows extend through June to fully protect a number of estuarine species. (DFG 1, pp. 2-5.) During June, sufficient outflow should be provided to maintain X2 in Suisun Bay (between 75 km and 64 km). (DFG closing comments, p. 7; DFG 2, p. 6.)

The State Water Board recognizes that the target flow volumes of 9.1 MAF (Jan-Mar, 51,000 cfs) and 6.3 MAF (Mar-May, 35,000 cfs) in greater than or equal to approximately 45% and 47% of years, respectively, and the positioning of X2 in Suisun Bay during the month of June are necessary in order to promote increased abundance and improved productivity for longfin smelt and other desirable estuarine species. An approach based on a percentage of unimpaired flows is intended as a means of distributing flows to meet the above-mentioned criteria in a manner that more closely resembles the natural hydrograph. Such an approach also recognizes the importance of preserving the general attributes of the flow regimes to which the native estuarine species are adapted.

Analyses of historic conditions (1921 to 2003), indicates that at 75% of unimpaired flows, average flows of 51,000 cfs occurred between January and March in approximately 35% of years, while average flows of 35,000 cfs happened between March and May in 70% of years. At 75% of unimpaired flow, X2 would be maintained west of Chipps Island more than 90% of the time between January and June (analyses not shown). Rather than advance multiple static flow criteria for the January through March, March through May, and June time periods, the State Water Board determines, as a Category A criterion, that 75% of 14-day average unimpaired flow is needed during the January through June time period to promote increased abundance and improved productivity for longfin smelt and other desirable estuarine species. It is important to note that this criterion is not a precise number; rather it reflects the general timing and magnitude of flows needed to protect public trust resources in the Delta ecosystem. However, this criterion could serve as the basis from which future analysis and adaptive management could proceed.

Given the extensive modifications to the system there may be a need to diverge from the natural hydrograph at certain times of the year to provide more flow than might have actually occurred to compensate for such changes. Fall outflow criteria, intended to improve conditions for Delta smelt by enhancing the quantity and quality of habitat in wet and above normal water years, represent such an instance. As a Category B criterion, the State Water Board determines that sufficient outflow is needed from September

through November of wet and above normal water year types to position X2 at less than or equal to 74 km and 81 km, respectively (Fall X2 action). In addition, the Delta Outflow Objectives contained within the Bay-Delta Plan for July through December are advanced as a Category B criterion. The State Water Board does not recommend increasing fall flows beyond those stipulated in the Bay-Delta Plan and Fall X2 action at this time. The quantity and timing of fall outflows necessary to protect public trust resources warrants further evaluation.

Category A: Winter – Spring Net Delta Outflows

The flow regime is important in determining physical habitat in aquatic ecosystems, which is in turn a major factor in determining biotic composition. (DEFG 1.) Bunn and Arthington (2002) highlight four principles by which the natural flow regime influences aquatic biodiversity: 1) developing channel form, habitat complexity, and patch disturbance, 2) influencing life-history patterns such as fish spawning, recruitment, and migration, 3) maintaining floodplain and longitudinal connectivity, and 4) discouraging non-native species. Altering flow regimes affects aquatic biodiversity and the structure and function of aquatic ecosystems. The risk of ecological change increases with greater flow regime alteration. (Poff and Zimmerman 2010.)

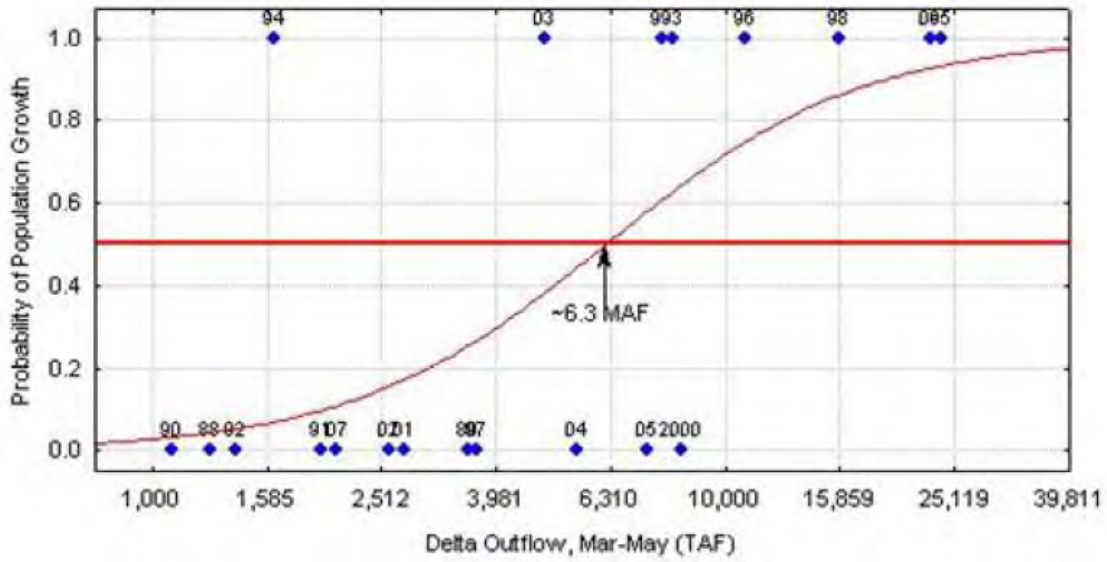
A suite of native, and recreationally or commercially important species were evaluated in an effort to assess the timing, volume, and quality of water necessary to protect public trust resources. Flow criteria were developed for each of the species identified by DFG as those that are priority concern and will benefit the most as a result of improved flow conditions. (DFG closing comments, p. 3.) For Delta outflow, this included longfin smelt, delta smelt, starry flounder, American shad, bay shrimp (*Crangon* sp.), mysid shrimp, and *Eurytemora affinis*. Through this process, data or information pertaining to life history attributes (e.g., timing of migration, spawning, rearing), relationships of species abundance or habitat to Delta outflow, season or time period when flow characteristics are most important, factors influencing and/or limiting populations, and other characteristics were assessed and summarized in the individual species write-ups.

Statistically significant relationships between annual abundance and X2 (or outflow) have been demonstrated for a diverse assemblage of species within the estuary. (Stevens and Miller 1983; Jassby et al. 1995; Kimmerer 2002a; Rosenfield and Baxter 2007; Kimmerer *et al*. 2009.) The causal mechanisms underlying the variation in annual abundance indices of pelagic species in the estuary are poorly understood, but likely vary across species and life stages.

Longfin smelt have the strongest X2-abundance relationship of those species for which such a relationship has been demonstrated. (Kimmerer et al. 2009.) Abundance indices for this species are inversely related to X2 during its winter-spring spawning and early rearing periods. (Stevens and Miller 1983; Jassby et al. 1995; Kimmerer 2002a; Rosenfield and Baxter 2007; Kimmerer et al. 2009.) However, a four-fold decline in the relationship, with no significant change in slope, occurred after 1987, coincident with the introduction and spread of the introduced clam *Corbula amurensis.* (Kimmerer 2002a.) Reduced prey availability due to clam grazing has been identified as a likely mechanism for the decline in the X2-abundance relationship. (Kimmerer 2002a.)

One of the key biological goals of the informational proceeding was to identify the flows needed to increase abundance of native and other desirable species. Logit regression (StatSoft 2010, as cited in TBI/NRDC 2, p.17) was used to address the question: What

outflow corresponded to positive longfin smelt population growth 50% of the time in the past? Logit regression is used to find a regression solution when the response variable is binary. For the purpose of this analysis, the generation-over-generation changes in abundance indices were converted to a binary variable (increase = 1 or decrease = 0). The analysis was conducted using FMWT abundance indices for the period extending from 1988 to 2007 (post-*Corbula*). Two periods of the winter-spring seasons (January to March and March to May) were evaluated, as different life stages of longfin smelt are present in the Delta during those periods (spawning adults and larvae/juveniles, respectively) and the mechanisms underlying the flow-abundance relationship may occur and/or vary in some or all of the months during these periods. (TBI/NRDC 2, p. 13.) The results were statistically significant ($p < 0.015$) and revealed that the "likelihood" of an increase in FMWT abundance index in 50% of years corresponded with flows of approximately 9.1 MAF and 6.3 MAF during January through March and March through May, respectively. (Figure 11, TBI/NRDC 2, pp. 17-19.)



Logit regression showing relationship between March through May Delta outflow and generation-over-generation change in abundance of longfin smelt (measured as the difference between annual FMWT abundance indices). Positive changes in the abundance index were scored at "1" and declines were scored as "0". Arrow indicates flows above which growth occurred in more than 50% of years. Point labels indicate year of the FMWT index. (Source: TBI 2, Figure 15.)

Figure 11. Logit Regression Showing Relationship Between March through May Delta Outflow and Generation-Over-Generation Change in Longfin Smelt Abundance

A similar analysis was conducted for bay shrimp (*Crangon* sp.), a species whose flow-abundance relationship did not experience a "step decline" following the invasion of *Corbula.* (Kimmerer 2002a.) Results of the logit analysis indicate that abundance indices for this species increased in about 50% of years when flows during March through May were approximately 5 MAF. (TBI/NRDC 1, p. 17.) Therefore, flows

associated with positive changes in the longfin smelt abundance index are anticipated to improve the likelihood of increases in bay shrimp abundance as well.

An analysis of historical longfin smelt flow-abundance relationships that corresponded to recovery targets in the Recovery Plan for the Sacramento/San Joaquin Delta Native Fishes (USFWS 1996) was also conducted. During the periods of January through March and March through May, cumulative Delta outflows of greater than 9.5 MAF and greater than 6.3 MAF, respectively, historically corresponded to abundance indices equal to or exceeding the recovery targets. (TBI/NRDC 2, p. 14.) These results are based on the intersection of the 1967 to1987 flow-abundance relationship and the recovery target. Use of the 1988 to 2007 flow-abundance relationship predicts lower abundance indices per any given flow, as compared to the historical relationship. Use of the pre-*Corbula* flow-abundance relationship underscores the need to address other stressors that may be affecting longfin smelt abundance concurrently with improved flow conditions. (TBI/NRDC 2, p. 14.) Applying this method and the logit regression produces very similar results.

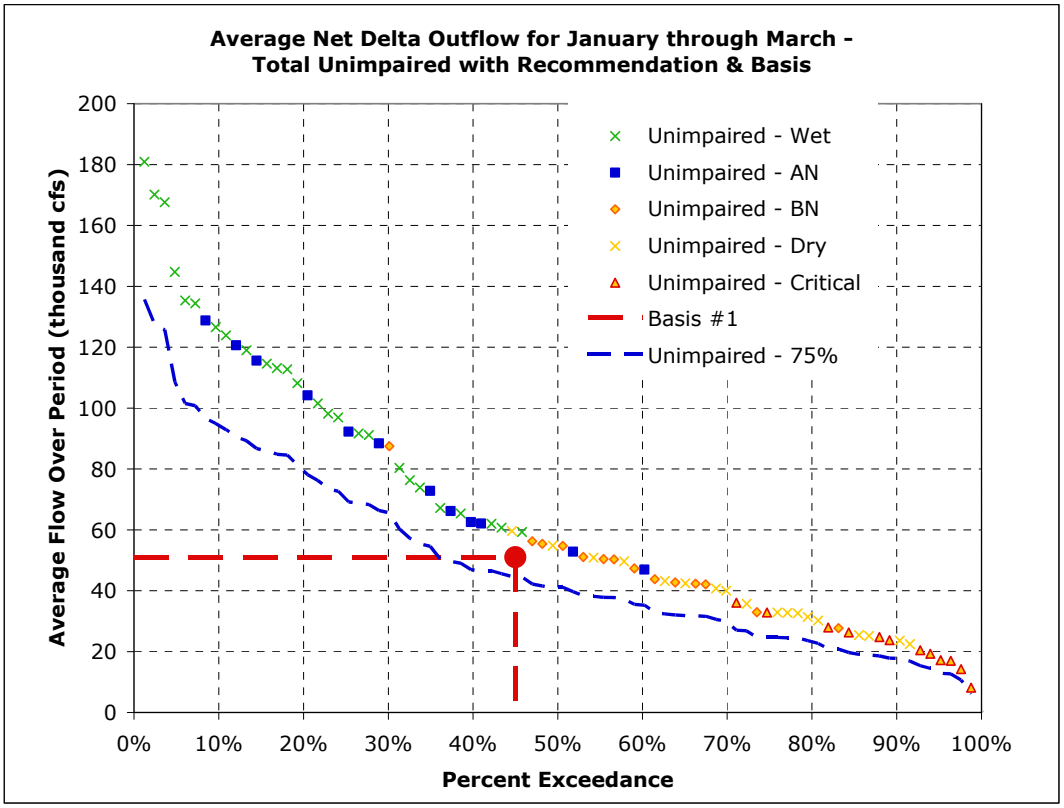
As noted above, the results of the logit analysis indicate that the "likelihood" of an increase in the longfin smelt FMWT abundance index in 50% of years corresponded with flows of approximately 9.1 MAF and 6.3 MAF during January through March and March through May, respectively. (TBI/NRDC 2, pp. 17-19.) Hereafter, these two flow volumes are reported in cubic feet per second, as 51,000 cfs and 35,000 cfs, respectively. Analyses indicate that under historic unimpaired conditions (1921 to 2003) average flows of 51,000 cfs occurred between January and March in approximately 50% of years (Figure 12a), while average flows of 35,000 cfs happened between March and May approximately 85% of the time (Figure 13a). The review of the historic record suggests that it is unrealistic to expect a 100% return frequency for the two magnitudes. A point of reference for determining a more realistic return frequency might be the actual (impaired) flows that occurred from 1956 to 1987. This was a time period when native fish were more abundant than today. Actual average flows between 1957 and 1987 of 51,000 cfs occurred between January and March in approximately 45% of years (Figure 12b). Similarly average flows of 35,000 cfs occurred between March and May 47% of the time (Figure 13b). However, since 2000, average flows of this magnitude only occurred about 27% and 33% of the time, respectively (Figures 12b and 13b). At 75% of unimpaired flow, average flows of 51,000 and 35,000 cfs would happen 35% and 70% of the time, respectively (Figure 12a and Figure 13a). Finally, the DFG has indicated that spring outflows should continue through June to fully protect a number of estuarine species (DFG 1, pp.2-5.)

A fixed 75% of unimpaired flow would extend the flow criteria to other years and distribute flows in a manner that more closely resembles the natural hydrograph. Expression of this criterion as a 14-day running average would better reflect the timing of actual flows (compared with a 30-day running average) while still allowing for a time-step to which reservoirs could be operated. The appropriateness of the 14 day averaging period warrants further evaluation. The unimpaired flows from which the 75% criterion is calculated are monthly values. Estimates of 14-day average unimpaired flows have not been published, but a cursory analysis indicates that they are likely to generate an exceedance curve similar to one generated with monthly values.

The State Water Board therefore determines that the Net Delta Outflow criterion be 75% of the 14-day average unimpaired flow between January and June (Figure 14a, Table

20). Consistent with the DFG recommendation (closing comments, p. 7) that X2 be maintained between 65 and 74 km (Chipps Island and Port Chicago) from January through June, a criterion of 75% of unimpaired flow, would maintain X2 west of Chipps Island more than 90% of the time, between January and June, based on monthly averages (analyses not shown). The return frequency for all months combined is about 98% of the time (Figure 14a). This compares with about a 90% percent return frequency between 2000 and 2009 (Figure 14b).

a)



b)

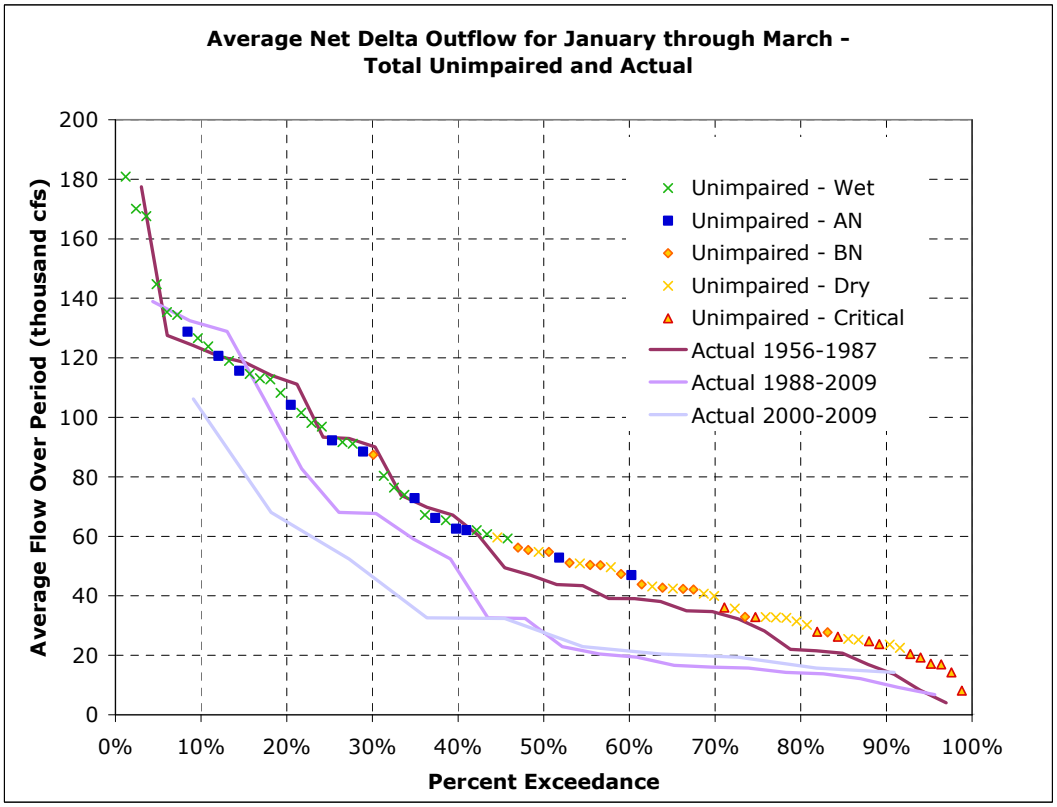
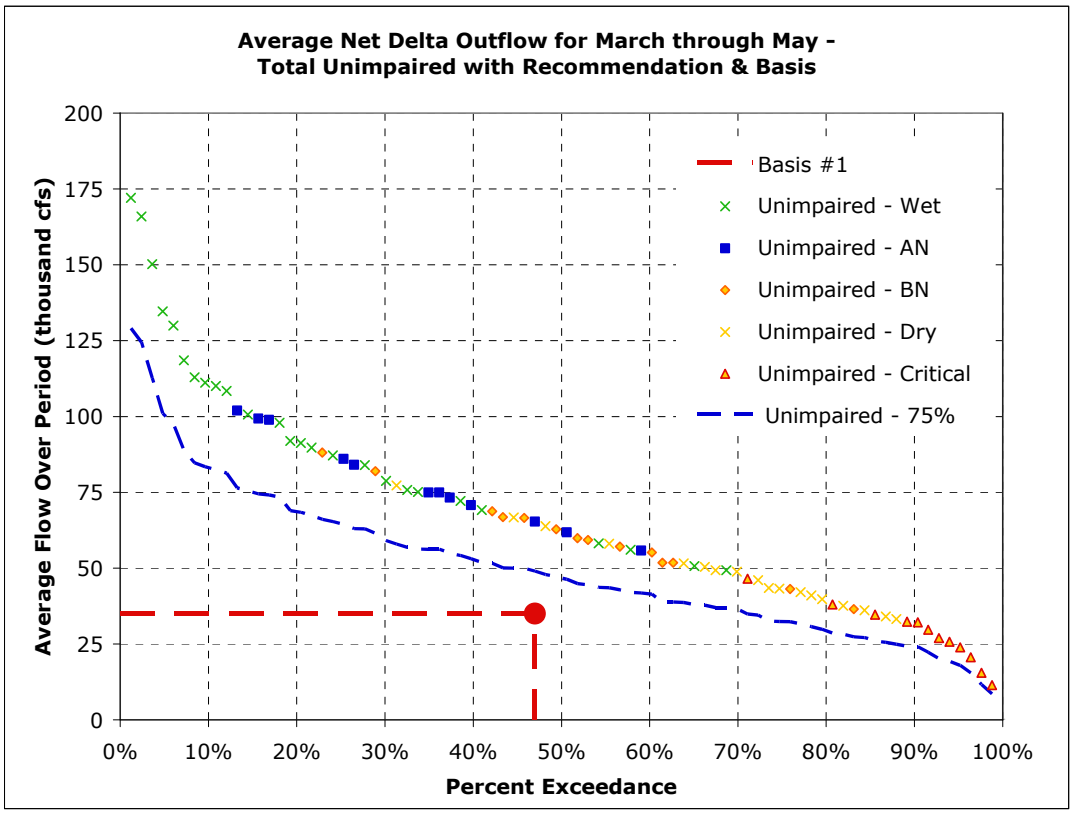


Figure 12. Net Delta Outflow Flow Exceedance Plot - January through March

a)



b)

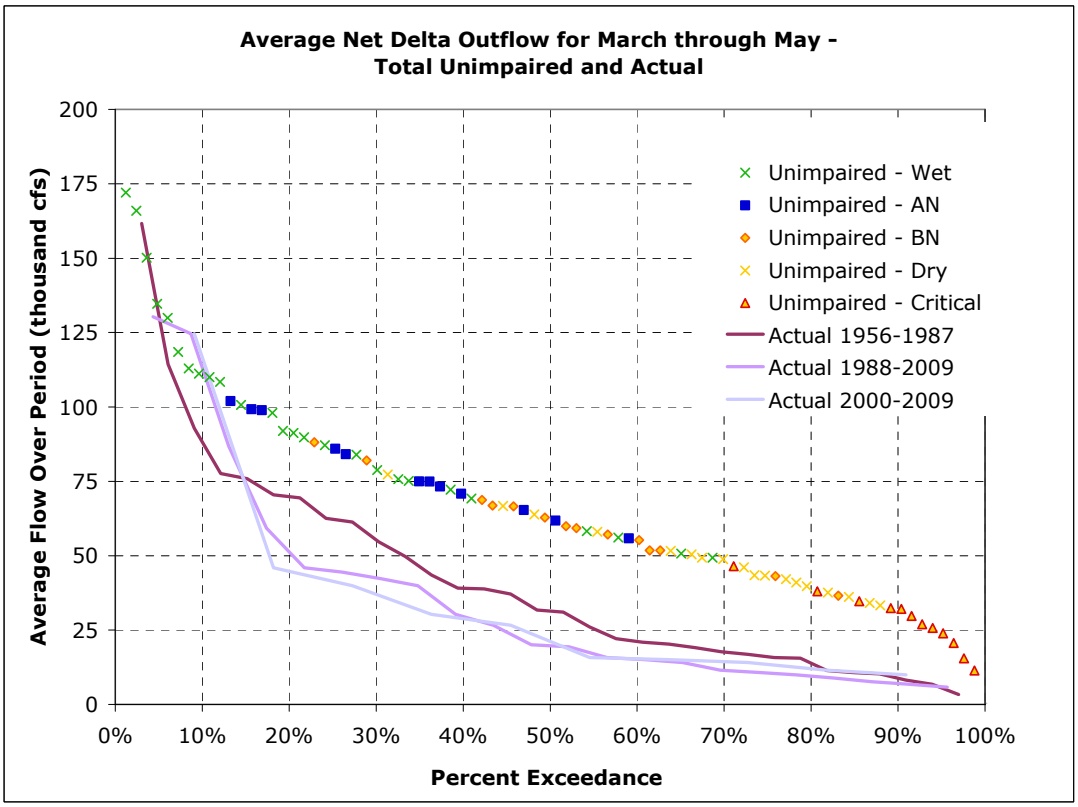
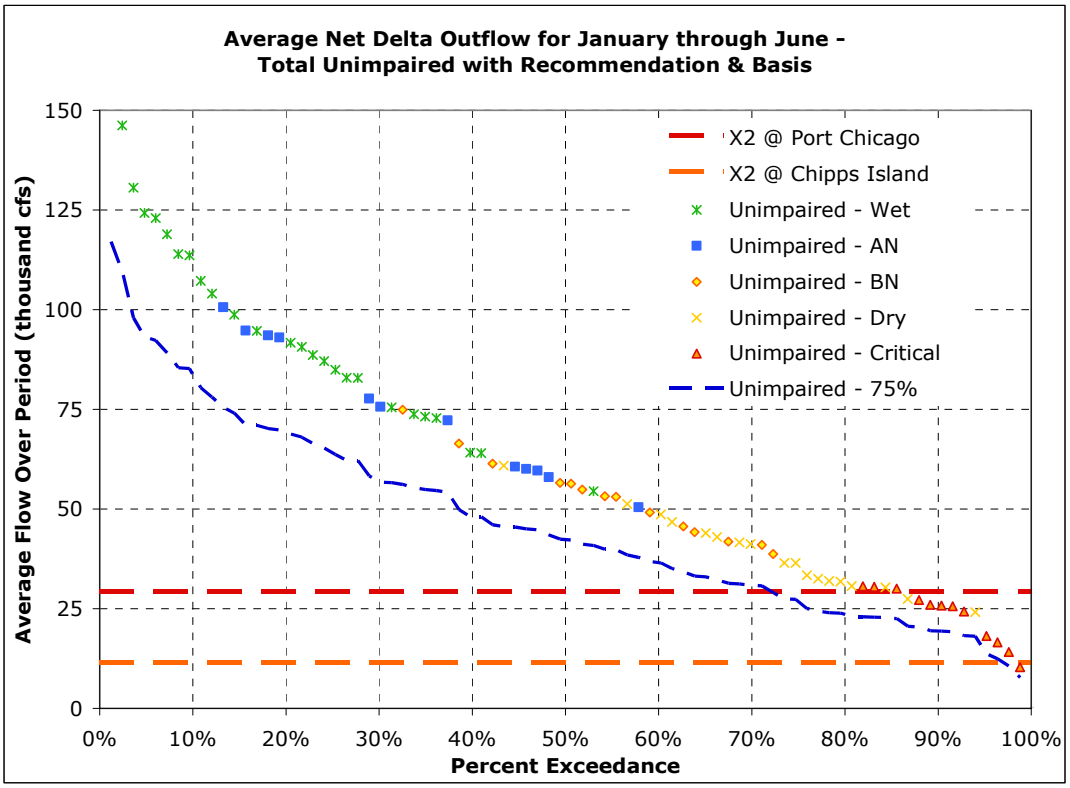


Figure 13. Net Delta Outflow Flow Exceedance Plot - March through May

a)



b)

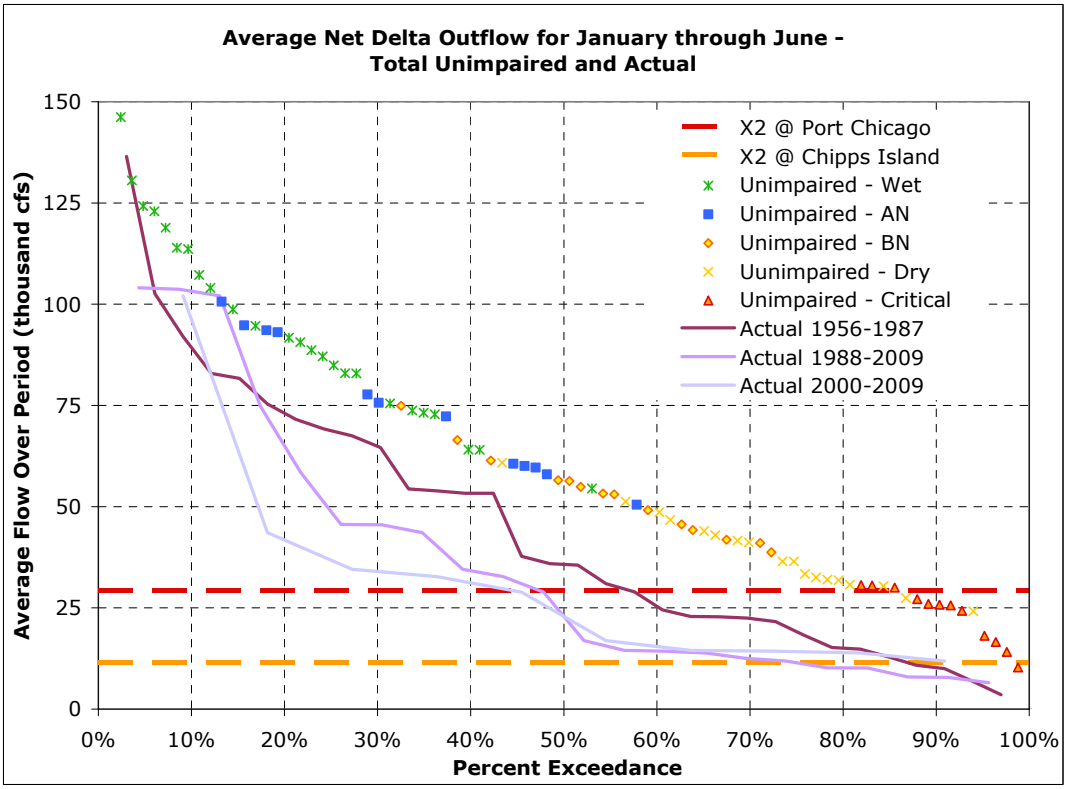


Figure 14. Net Delta Outflow Flow Exceedance Plot - January through June

The net Delta outflow criterion of 75% of unimpaired flows from January through June is anticipated to increase the likelihood of positive population growth for a number of other public trust species, notably those for which abundance-X2 relationships have been demonstrated, including American shad, striped bass, starry flounder, bay shrimp (*Crangon franciscorum*), and *Eurytemora affinis* (spring abundance). For example, the spring (March through May) abundance of *Eurytemora affinis* has been positively related to flow, following the invasion of *Corbula.* (Kimmerer 2002a.) This species represents an important prey item for most small fishes, particularly those with winter and early spring larvae, such as longfin smelt, delta smelt and striped bass. (Lott 1998, Nobriga 2002, Bryant and Arnold 2007, DFG unpublished.) Increases in the abundance of prey species, such as *E. affinis* and bay shrimp, has the potential to improve productivity of the estuarine food web and benefit a number of fishes, especially given that food limitation has been identified as a potential contributing factor in the POD. (Baxter *et al*. 2008.) Additional information concerning the relationship of population abundance to flow for these species is provided in the species life history section of this report.

Delta smelt abundance does not respond to freshwater outflow in a predictable manner similar to that of other numerous estuarine species. (Stevens and Miller 1983; Jassby et al. 1995; Kimmerer 2002a.) However, freshwater outflow during spring (March to June) does affect the distribution of delta smelt larvae by transporting them seaward toward the low salinity zone. (Dege and Brown 2004.) Ideal rearing habitat conditions for this species are believed to be shallow water areas most commonly found in Suisun Bay. (Bennett 2005.) Outflows that locate X2 in Suisun Bay (mean April through July location) produce the highest delta smelt abundance levels; however, low abundances have also been observed under the same conditions, which indicates several mechanisms must be operating. (Jassby et al. 1995; DFG 1, p. 15.) A criterion of 75% of unimpaired flow is expected to place X2 in Suisun Bay from March through June in nearly all years.

The DFG's current science-based conceptual model is that placement of X2 in Suisun Bay represents the best interaction of water quality and landscape for fisheries production given the current estuary geometry. (DFG 2, p. 6.) The DFG (closing comments, p. 7) provided recommended flow criteria for the Delta based on the placement of X2, for January through June (exact period varied by species), for longfin smelt, starry flounder, bay shrimp, zooplankton, and American shad. For each of these species, the DFG (*Id*.) recommends that sufficient outflow be provided to position X2 between 75 km and 64 km. These criteria are generally consistent with spring X2 requirements in the 2006 Bay-Delta Plan, which requires salinity at one compliance point (81 km) not to exceed 2 psu continuously, and at two other compliance points (64 km [Port Chicago] and 75 km [Chipps Island]) not to exceed 2 psu for a set number of days during February through June. Positioning X2 at 75 km and 64 km is equivalent to a 3-day running average Net Delta Outflow Index of 11,400 cfs and 29,200 cfs, respectively. Implementation of the 75% of unimpaired flow criteria would be largely consistent with the intent of the DFG's recommendations by placing X2 between Chipps Island and Port Chicago, or further to the west, in nearly all years during the January through June period.

The step-decline in the abundance-X2 relationship that occurred after 1987 for many of these species in combination with the lack of understanding concerning the causal mechanisms underlying those relationships leads to uncertainty regarding the future response of these species to elevated flows. In addition, a number of major changes to

the Delta landscape, including levee failure and island flooding, are likely to occur over the next several decades. (Lund et al. 2007, 2008.) Flow regimes needed to maintain desired environmental conditions will change through time, in response to changes in the geometry of waterways, climate, and other factors. A number of "stressors" are currently being evaluated as potential contributors to the POD, including attributes of physical and chemical fish habitat. (Sommer et al. 2007; Baxter et al. 2008.) Increasing flows, without concurrent improvements to habitat and water quality, would decrease the extent of expected improvements in native species abundances and habitats. (DOI 1, p. 40.) However, the scientific information received during this proceeding supports the conclusion that flow, though not sufficient in and of itself, is necessary to protect public trust resources and that the current flow regime has harmed native species and benefited non-native species. Each of these issues adds further support to the need for a strong adaptive management program.

The specific flow criteria may need to be tempered by the need to maintain water in reservoirs to provide adequate cold water resources to support egg incubation, juvenile rearing, and holding in the Sacramento River, San Joaquin River, and associated tributary basins. It may not be possible to attain the outflow criteria and meet the thermal needs of the various runs of Chinook salmon and other sensitive species in certain years. Water supply modeling and temperature analyses should be conducted to identify conflicting requirements to achieve both outflow and cold water temperature goals.

Category B: Fall X2

Abiotic habitat parameters for delta smelt have been described for both the summer and fall seasons as combinations of salinity, temperature, and turbidity. (Nobriga et al. 2008; Feyrer et al. 2007; Feyrer et al. in review.) During fall, delta smelt typically occur in low salinity rearing habitats located around the confluence of the Sacramento and San Joaquin Rivers. Suitable abiotic habitat for delta smelt during fall has been defined as relatively turbid water (Secchi depths < 1.0 m) with a salinity of approximately 0.6-3.0 psu. (Feyrer et al. 2007.) Long-term trend analysis has shown that environmental quality, as defined by salinity and turbidity, has declined across a broad geographical range, most notably within the south-eastern and western regions of the Delta, leaving a relatively restricted area in the lower Sacramento River and around the confluence of the Sacramento and San Joaquin rivers with the least habitat alteration, compared to the rest of the upper estuary. (Feyrer et al. 2007, DOI 1, p.34.)

The amount of habitat available to delta smelt is controlled by freshwater flow and how that flow affects the position of X2, geographically, in the estuary (Figure 15). (Feyrer et al. in review.) Through the use of a 3D hydrodynamic model, Kimmerer et al. (2009) showed that the extent of delta smelt habitat, as defined by salinity, increases as X2 moves seaward. When X2 is located downstream of the confluence of the Sacramento and San Joaquin rivers, suitable abiotic habitat extends into Suisun and Grizzly bays, resulting in a large increase in the total area of suitable abiotic habitat. (Feyrer et al. in review.) The average position of X2 during fall has moved upstream, resulting in a corresponding reduction in the amount and location of suitable abiotic habitat. (Feyrer et al. 2007; Feyrer et al. in review.)

Average Net Delta Outflow for September, October, and November are presented in Figure 16, Figure 17, and Figure 18. Historically, unimpaired flows in fall were independent of water year type. Interestingly, actual outflow was greater than

unimpaired flow between 1956 and 1987. However, fall outflows have fallen since then and since 2000 are almost always less than unimpaired flow. This is consistent with the observations of Feyrer et al. (2007) that fall X2 has moved upstream and this has reduced the amount of available habitat for smelt in fall.

Fall conditions may be very important for delta smelt, since this period of time coincides with the pre-spawning period for adult delta smelt. (Feyrer et al. 2007.) In general, reductions in habitat constrict the range of these fishes, which combined with an altered food web, may affect their health and survival. (Feyrer et al. 2007.) There is a statistically significant stock-recruitment relationship for delta smelt in which pre-adult abundance measured by the FMWT positively affects the abundance of juveniles the following year in the Summer Townet survey. (Bennett 2005; Feyrer et al. 2007, as cited in USFWS 2008.) Incorporating the combined effects of specific conductance and Secchi depth improved the stock-recruitment relationship. (Feyrer et al. 2007.)

Feyrer et al. (In Review) demonstrated that delta smelt are more abundant when a large amount of habitat is available. However, the relationship between habitat area and FMWT abundance is complex and not strong. (NAS 2010.) When the area of highly suitable habitat is low, either high or low FMWT indices can occur (Figure 15). Therefore, delta smelt can be successful in instances where habitat is limited. More important, however, is that the lowest abundances all occurred when the habitat-area index was less than 6,000 ha. (Feyrer et al. in review; NAS 2010.) This potentially suggests that while reduced habitat area may be an important factor associated with the worst population collapses, it is not likely the only cause of the collapse. (NAS 2010.)

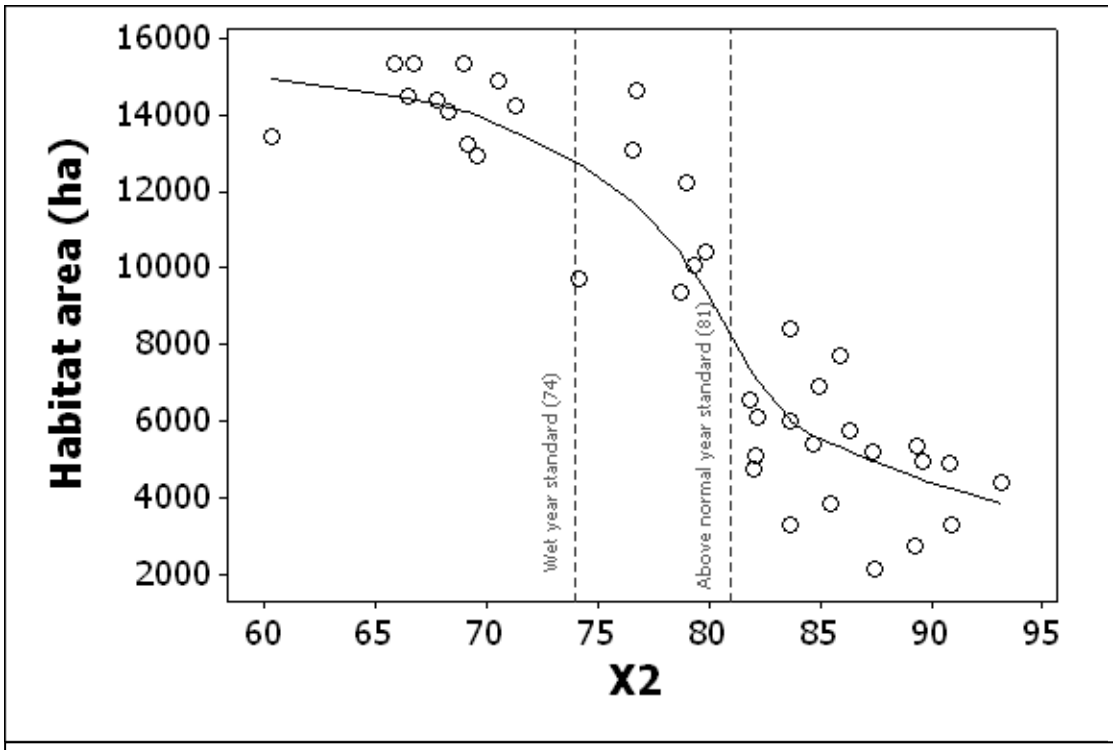
The fall X2 action described in the USFWS Opinion is focused on wet and above normal years because these are the years in which project operations have most significantly affected fall outflows. Actions in these years are more likely to benefit delta smelt. (USFWS 2008.) The action calls for maintaining X2 in the fall of wet years and above-normal years at 74 km and 81 km, respectively. (Figures 14, 15, and 16; USFWS 2008.) In addition to increasing the quality and quantity of habitat for delta smelt, moving X2 westward in the fall may also reduce the risk of entrainment by increasing the geographic and hydrologic distance of delta smelt from the influence of the Project export facilities. (DOI 1, p. 34.)

The NAS (2010) commented on this action in their review of the USFWS Opinion and concluded:

> "The X2 action is conceptually sound in that to the degree that habitat for smelt limits their abundance, the provision of more or better habitat would be helpful. However, the examination of uncertainty in the derivation of the details of this action lacks rigor. The action is based on a series of linked statistical analyses (e.g., the relationship of presence/absence data to environmental variables, the relationship of environmental variables to habitat, the relationship of habitat to X2, the relationship of X2 to smelt abundance), with each step being uncertain. The relationships are correlative with substantial variance being left unexplained at each step. The action also may have high water requirements and may adversely affect salmon and steelhead under some conditions (memorandum from USFWS and NMFS, January 15, 2010). As a result, how specific X2

targets were chosen and their likely beneficial effects need further clarification."

The State Water Board determines that inclusion of the delta smelt fall X2 action as a Category B flow criterion, consistent with requirements stipulated in the USFWS Opinion will likely improve habitat conditions for delta smelt. However, in light of the uncertainty about specific X2 targets and the overall effectiveness of the fall X2 action, the State Water Board recommends this action be implemented within the context of an adaptive management program. The program should include studies designed to clarify the mechanisms underlying the effects of fall habitat on the delta smelt populations, the establishment and peer review of performance measures and performance evaluation related to the action, and a comprehensive review of the outcomes of the action and effectiveness of the adaptive management program. (USFWS 2008.) Absent study results demonstrating the importance of fall X2 to the survival of delta smelt, fall flows beyond those stipulated in the fall X2 action for the protection of delta smelt are not recommended at this time.



Relationship between X2 and habitat area for delta smelt during fall, with standard shown for wet and above normal years. (Source: USFWS 2008, Figure B17).

Figure 15. X2 Versus Habitat Area for Delta Smelt During Fall

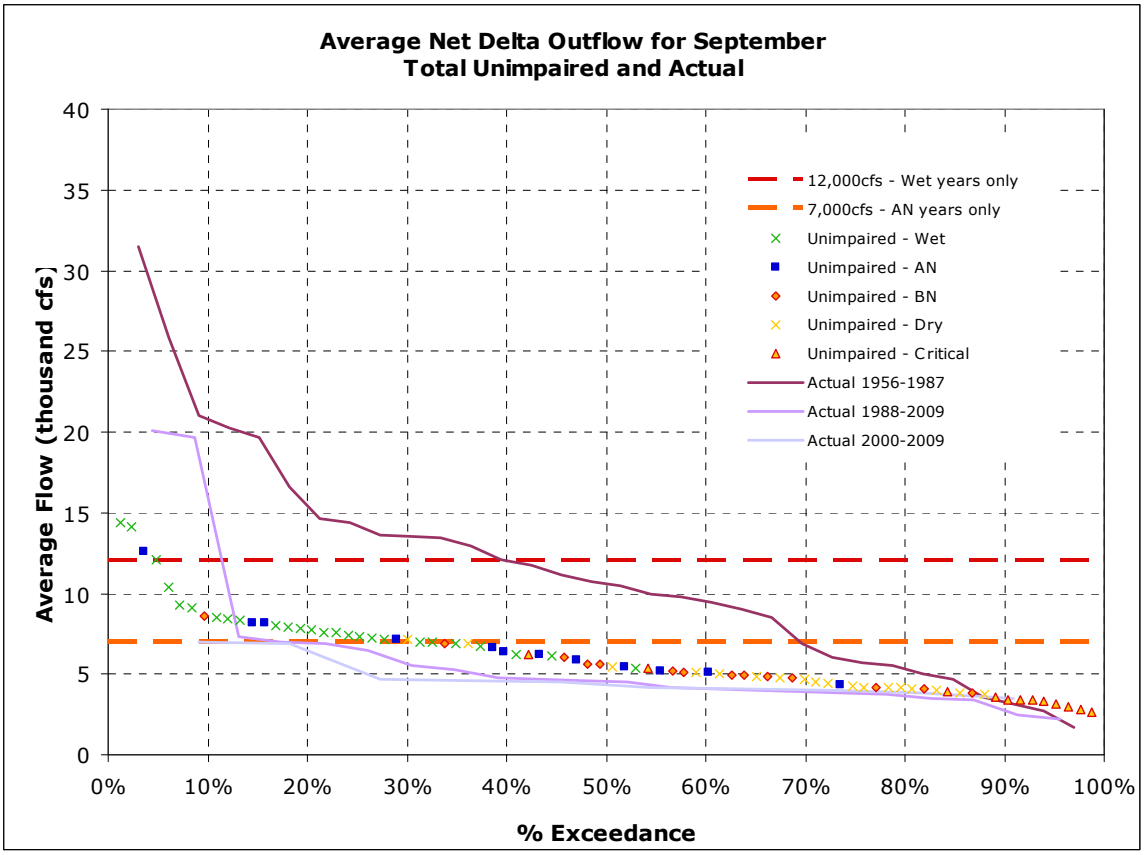


Figure 16. Net Delta Outflow Flow Exceedance Plot - September

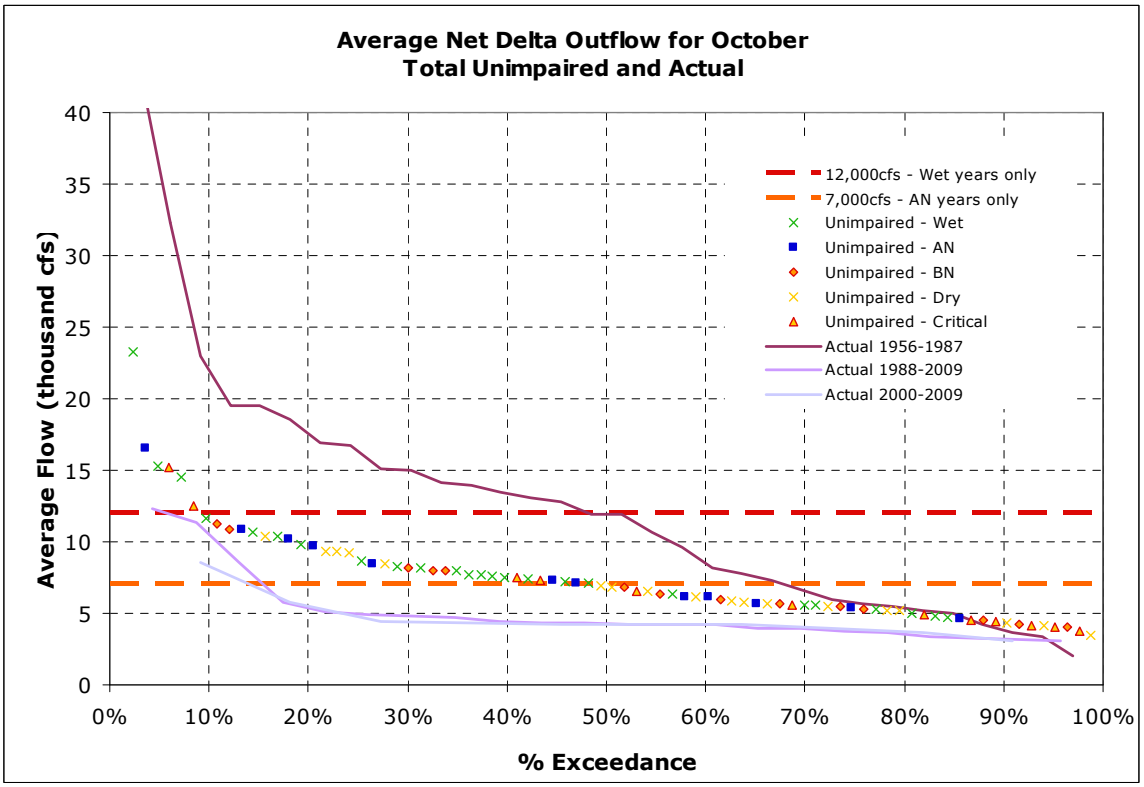


Figure 17. Net Delta Outflow Flow Exceedance Plot - October

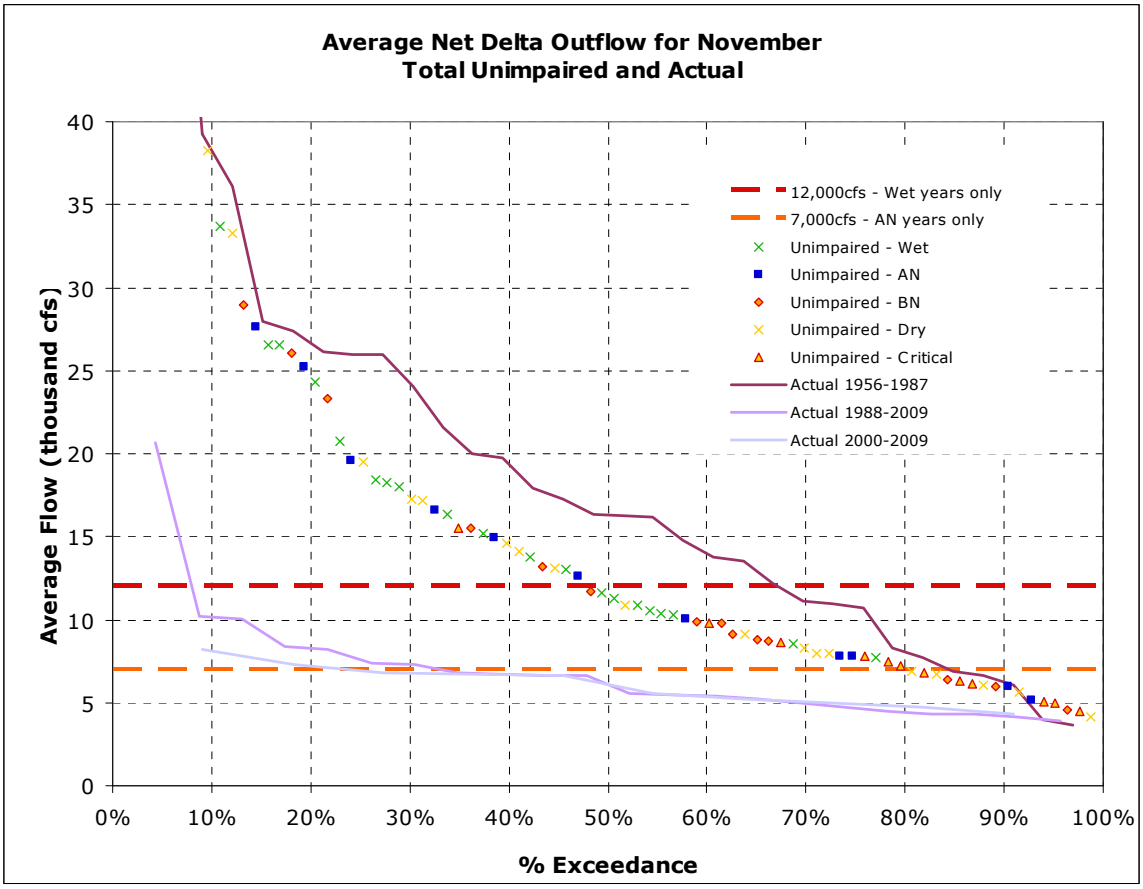


Figure 18. Net Delta Outflow Flow Exceedance Plot - November

The specific Delta outflow criteria may need to be tempered by the need to maintain water in reservoirs to provide adequate cold water and tributary specific flows on tributaries to the Delta. It may not be possible to attain both the flow criteria and meet the thermal and tributary specific flow needs of all of the sensitive species in the Delta Watershed. Water supply modeling and temperature analyses should be conducted to identify conflicting requirements to achieve both flow and cold water temperature goals.

Category B: 2006 Bay-Delta Plan Summer – Fall Delta Outflow

Resident estuarine species, such as delta smelt, require flows sufficient to provide adequate habitat throughout the year. Delta outflow criteria for January through June are discussed above. In addition to providing flows to support resident species, sufficient flows must also be provided in the fall to provide attraction cues and a homing mechanism for returning adult salmon. Criteria for fall salmon attraction flows on the Sacramento and San Joaquin rivers are discussed in Sections 5.2 and 5.3. The 2006 Bay-Delta Plan contains summer – fall Delta outflow water quality objectives for fish and wildlife beneficial uses, which are summarized below in Table 19.

Table 19. 2006 Bay-Delta Plan Delta Outflow Objectives for July through December

Water Year	July	Aug	Sept	Oct	Nov	Dec
Critical	4000	3000	3000	3000	3500	3500
Dry	5000	3500	3000	4000	4500	4500
Below Normal	6500	4000	3000	4000	4500	4500
Above Normal	8000	4000	3000	4000	4500	4500
Wet	8000	4000	3000	4000	4500	4500

Multiple participants submitted testimony concerning the need for additional flows in the fall to benefit delta smelt, striped bass, and other resident species (CSPA 1, p. 7; CWIN 2, p. 29; DOI 1, pp. 46-48; EDF 1, pp. 49-50; TBI/NRDC 2, pp. 27-37), and as a means to potentially control the spread of harmful invasive species (e.g., *Corbula* and toxic algae). (TBI/NRDC 2, pp. 27-37.) The recommendations were based largely on recent research conducted by Feyrer *et al*. (2007 and In Review) and the fall X2 action in the USFWS's Opinion. The Fall X2 action in the USFWS Opinion requires that sufficient outflow be provided in September through November of Above Normal and Wet water year types to position X2 at 81 km and 74 km, respectively. This action was restricted to Above Normal and Wet years because these are the years in which project operations have most significantly affected fall outflows and to limit potential conflicts with cold water pool storage. (USFWS 2008.)

Following its review of the USFWS Opinion, the NAS (2010) noted that:

> "[a]lthough there is evidence that the position of X2 affects the distribution of smelt, the weak statistical relationship between the location of X2 and the size of smelt populations makes the justification for this action difficult to understand The X2 action is conceptually sound in that to the degree that the amount of habitat available for smelt limits their abundance, the provision of more or better habitat would be helpful the committee concludes that how specific X2 targets were chosen and their likely beneficial effects need further clarification."

The USFWS Opinion also recognized uncertainty concerning the position of fall X2 and subsequent abundance of delta smelt and requires that the action be implemented with an adaptive management program to provide for learning and improvement of the action over time.

However, some participants provided flow recommendations that called for increased fall outflows during all water year types, as compared to the objectives in the 2006 Bay-Delta Plan, and in certain instances in excess of those required by the USFWS Opinion. Given the need for improved understanding concerning the fall X2 criterion, including the mechanisms underlying the effects of fall habitat on delta smelt populations, determination of specific X2 targets, potential conflicts with cold water pool storage, and the likely effectiveness of the action, the State Water Board is not advancing criteria for increased fall flows in Critical, Dry, and Below Normal water year types beyond those required in the 2006 Bay-Delta Plan and in Above Normal and Wet water year types beyond those stipulated in the fall X2 action (Category B). The quantity and timing of fall outflows necessary to protect public trust resources warrants further evaluation and underscores the need for a well-designed adaptive management program. The potential

to use variability in flows during summer and fall months as a means of controlling the distribution and abundance of invasive species should also be evaluated.

5.2 Sacramento River

Following are the Sacramento River inflow criteria based on analysis of the species-specific flow criteria and other measures:

1) Sacramento River Flow at Rio Vista: 75 percent of 14-day average unimpaired flow from April through June to increases juvenile salmon outmigration survival for fall-run Chinook salmon
2) Sacramento River Flow at Rio Vista: 75 percent of 14-day average unimpaired flow from November through March to increases juvenile salmon outmigration survival for other runs of Chinook salmon
3) Sacramento River at Wilkins Slough: Provide pulse flows of 20,000 cfs for 7 days starting in November coincident with fall/early winter storm events; the timing, magnitude, duration, and number of pulses should be determined on an adaptive management basis informed by unimpaired flow conditions and monitoring of juvenile salmon migration to promote juvenile salmon emigration
4) Sacramento River Flow at Freeport: Provide flows of 13,000 to 17,000 cfs in the Sacramento River downstream of confluence with Georgiana Slough when salmon are migrating through the Delta from November through June to increase juvenile salmon outmigration survival by reducing straying into Georgiana Slough and the central Delta
5) Sacramento River at Rio Vista: 2006 Bay-Delta Plan flow objectives for September and October to provide Fall adult Chinook salmon attraction flows

The magnitude, duration, timing, and source of Sacramento River inflows are important to all runs of Chinook salmon migrating through the Bay-Delta and several different aspects of their life history. Inflows are needed to provide appropriate conditions to cue upstream adult migration to the Sacramento River and its tributaries, adult holding, egg incubation, juvenile rearing, emigration from the Sacramento River and its tributaries, and other functions. Sacramento River inflows are important throughout the year to support various life stages of the different Chinook salmon runs inhabiting the Sacramento River. However, given the focus of this proceeding on inflows to the Delta and the importance of the juvenile salmon emigration period, the Sacramento River inflow criteria included in this report focus primarily on flows needed to support emigrating juvenile Chinook salmon from natal streams through the Delta. Following is a brief summary of the Sacramento River inflow criteria that were developed based on the species-specific flow needs analyses for salmon included in section 4.2.3 followed by a detailed discussion.

Available scientific information indicates that average April through June flows of 20,000 to 30,000 cfs on the Sacramento River at Rio Vista represent a flow threshold at which survival of juveniles and subsequent adult abundance is substantially improved for fall-run Chinook salmon. Less information is available for the other runs of Chinook salmon on the Sacramento River. However, outmigration flows needed to protect other races are assumed to be generally the same since factors that affect fall-run survival are generally applicable to other runs with some exceptions. In addition, analyses indicate that providing pulse flows of 20,000 cfs at Wilkins Slough on the Sacramento River beginning in November and extending through the first of the year provides for earlier

migration timing and increased survival of juvenile winter, spring, and late-fall run Chinook salmon. In addition, information indicates that flows of 13,000 cfs to 17,000 cfs may be needed on the Sacramento River at Freeport to prevent salmon from migrating through Georgiana Slough and the interior Delta where survival is substantially lower.

Continuity of flows from natal stream through the Delta and flow variability are also important so rather than static April through June threshold flows of 20,000 to 30,000 cfs, the State Water Board determines, as a Category A criterion, that 75% of unimpaired flow is needed to achieve a threshold flow of 25,000 cfs (average of 20,000 and 30,000 cfs) approximately 50% of the time. The same percentage of unimpaired flow for the November through March period is also advanced as a Category B criterion due to the lack of information upon which this criterion was based. In addition, as Category B criteria, the State Water Board determines that shorter pulse flows of 20,000 cfs for 7 days at Wilkins Slough are needed starting in November and extending through the first of the year and flows of 13,000 cfs to 17,000 cfs at Freeport are needed from November through June to provide additional protection for Sacramento River Chinook salmon. The State Water Board also advances the Sacramento River flow objectives from the Bay-Delta Plan during September and October to provide a minimal level of protection during these months pending development of additional information concerning flow needs during this period. All of the Sacramento River flow criteria are not precise; rather they reflect the general timing and magnitude of flows needed to protect public trust resources, but could serve as a reasonable basis from which future analysis and adaptive management could proceed. The criteria also do not consider other Sacramento River flow needs.

Sacramento River Inflow as a Percentage of Unimpaired Flows

It appears to be important to preserve the general attributes of the natural hydrograph to which the various salmon runs adapted over time. Information indicates that Chinook salmon respond to variations in flows and need some continuity of flow between natal streams and the Delta for transport and homing fidelity. As such, the historic practice of developing monthly flow criteria to be met from limited sources may be less than optimal for protecting Chinook salmon runs. At the same time, given the impediments to fish passage into historic spawning and rearing areas, there may also be a need to diverge from the natural hydrograph at certain times of year to provide more flow than might have naturally occurred or less flow such that those flows are available at other times of year to mitigate for passage and habitat issues (e.g. cold water pool management).

Based on the above, the State Water Board developed Sacramento River inflow criteria, intended to mimic the natural hydrograph during the peak emigration period, to protect emigrating juvenile Chinook salmon. While emigration of some runs may occur outside of this period, peak emigration is generally believed to occur between November through June. As such, the criteria are recommended to apply to this time period. To achieve the attributes of a natural hydrograph, the criteria are recommended as a percentage of unimpaired flow on a 14-day average, to be provided generally on a proportional basis from the tributaries to the Sacramento River. The 14-day average is intended to better capture the peaks of actual flows compared to a 30-day average time-step, while still allowing for a time-step at which facilities can be operated. The appropriateness of this time-step for protecting public trust resources should be further evaluated.

Spring Sacramento River Inflows at Rio Vista
The species-specific flow needs analyses for salmon in section 4.2.3 indicates that average April through June flows of 20,000 to 30,000 cfs on the Sacramento River at Rio Vista provide for improved survival and abundance of juvenile fall-run Chinook salmon on the Sacramento River.

Flow exceedance graphs were used to determine the percentage of flow needed to achieve various flows needed to protect Chinook salmon. Analysis of unimpaired flows at Freeport (Figure 19) shows that under historic unimpaired conditions, average April through June flows of 30,000 cfs or more would occur in approximately 60% of years. Flows of 25,000 cfs or more would occur is approximately 72% of years, and flows of 20,000 cfs or more would occur in roughly 85% of years. At 75% of unimpaired flows, average flows of 30,000 cfs would be achieved between April and June in roughly 37% of years, flows of 25,000 cfs would be achieved in roughly 50% of years, and flows of 20,000 cfs would be achieved in approximately 70% of years. At 50% of unimpaired flows, flows of 30,000 cfs would be achieved in approximately 15% of years, flows of 25,000 cfs in roughly 25% of years, and flows of 20,000 cfs in roughly 35% of years. Actual flows of 30,000, 25,000, and 20,000 cfs were met in 26, 32, and 39% of years, respectively between 1986 and 2005. It is important to note, however, that unimpaired flows between 1986 through 2005 are not necessarily representative of the longer term unimpaired flow record. Flow criteria equal to 75% of unimpaired flows during the April through June period, on average, would therefore provide favorable conditions for fall-run juvenile Chinook salmon in at least 50% of years (assuming 25,000 cfs flows). As a result, the State Water Board advances 75% of unimpaired flows on a 14-day average from April through June as a potential means to achieve the 20,000 to 30,000 cfs Sacramento River flow threshold discussed above while maintaining variability and the attributes of the natural hydrograph. This criterion is included as criterion 1) for Sacramento River flows and is a Category A criterion.

The unimpaired estimates from which the 75% criterion is calculated are monthly estimates. Estimates of 14-day unimpaired flow have not been published, but are expected to generate an exceedance curve similar to one generated with monthly estimates. This specific percent of unimpaired flow and the averaging period should be adaptively managed. More information and analyses should be conducted to determine if there are maximum flows above which no, or significantly diminishing, additional biological or geomorphological benefits are obtained. This criterion would allow for flows to vary over time coincident with precipitation events reflecting the natural hydrograph. Climate change, however, and its associated effect on flow patterns will likely change how effective such flows are in protecting Chinook salmon. As such, these flow criteria would need to be adaptively managed in the future to ensure the protection of Chinook salmon.

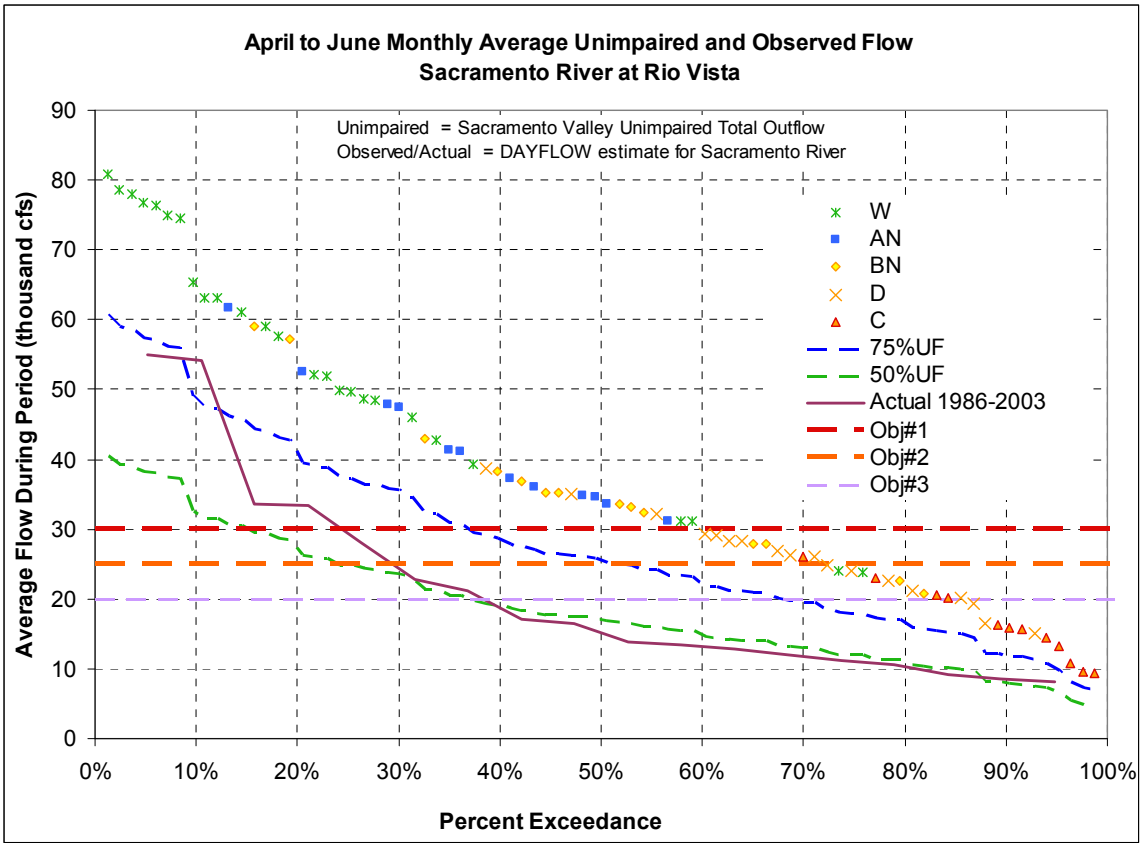


Figure 19. Sacramento River Flow Exceedance Plot - April through June

Fall and Winter Sacramento River Inflows at Rio Vista

Available data and analysis focus primarily on juvenile fall-run Chinook salmon outmigration. Outmigration flows to protect other races and life stages are assumed to be generally the same since factors that affect fall-run survival are generally applicable to other runs, with some exceptions including temperature, which may not be a concern in the winter months. (USFWS 1992, p. 8.) In the absence of sufficient data and analyses regarding flows needed for other Chinook salmon runs, however, the State Water Board advances 75% of unimpaired flows between November and March as an initial criterion from which future analysis and adaptive management could proceed. There is, however, no specific information that indicates that 75% is the correct percent of unimpaired flow. Additional quantitative analyses should be conducted to determine the specific flow needs of winter, spring, and late-fall run Chinook salmon.

Sacramento River Flow at Freeport

Analyses show that Chinook salmon survival is significantly lower for fish migrating through Georgiana Slough. Reverse flows in the vicinity of Georgiana Slough increase the occurrence of salmon migrating through Georgiana Slough. The available data show that flows of 13,000 to 17,000 cfs on the Sacramento River at Freeport provide adequate flow conditions to prevent reverse flows in Georgiana Slough. Flow criteria of 13,000 to 17,000 cfs on the Sacramento River at Freeport when salmon are migrating through the Delta during the November through June period is advanced as a Category B criterion. Additional analyses should be conducted to verify that flows of this magnitude are

needed to achieve the desired outcome of significantly reducing straying of outmigrating juvenile Chinook salmon. These flows are also expected to benefit adult Chinook salmon returning to the Sacramento River basin to spawn during this period. However, additional analyses regarding the relationship of adult Chinook salmon and reverse flows in Georgiana Slough should also be conducted.

Sacramento River Flow at Wilkins Slough

Information discussed in the species-specific flow needs analyses for salmon in section 4.2.3 indicates that significant precipitation in the Sacramento River in the fall facilitates emigration of juvenile Chinook salmon. When this flow is delayed, emigration of salmon is also delayed resulting in reduced survival to the Delta. The available data show that juvenile salmon require flows of 15,000 cfs to 20,000 cfs at Wilkins Slough by November continuing through the first of the year to facilitate emigration. These flows are needed to provide ecological continuity from natal streams to the Delta. Information supports a range of pulse flows of 15,000 cfs to 20,000 cfs at Wilkins Slough to be provided coincident with fall and early winter storm events. This range should be adaptively managed and further evaluated. Absent additional information, flows of 20,000 cfs for seven days are advanced. Such an approach will retain the attributes of the natural hydrograph and provide for ecological continuity. The timing, magnitude, duration, and number of pulses should be determined through adaptive management, informed by unimpaired flow conditions and monitoring of juvenile salmon migration. Additional analyses should be conducted regarding this flow relationship to refine these criteria and inform adaptive management.

Sacramento River at Rio Vista: 2006 Bay-Delta Plan Objectives

The above criteria cover flows on the Sacramento River from the November through June time period. In addition, the Bay-Delta Plan provides minimum flows from September through December. Aside from what is discussed above, there was no new information submitted in the record for this proceeding on fall flows and the Sacramento River fall flow objectives were not specifically reviewed. In the absence of any new information, the State Water Board advances the 2006 Bay Delta Plan Sacramento River inflow objectives for September and October as a Category B criterion. Given that Chinook salmon may also be present in the Sacramento River during July and August, it is likely warranted that some minimal flows be provided during those months as well. However, adequate information on which to base such flows was not readily available for this proceeding. Further, adequate minimal flows during this time period may be provided by temperature and other requirements and reservoir releases for power production and export operations.

The specific Sacramento River flow criteria may need to be tempered by the need to maintain water in reservoirs to provide adequate cold water and tributary specific flows in the Sacramento River basin. It may not be possible to attain both the flow criteria and meet the thermal and tributary specific flow needs of the various runs of Chinook salmon and other sensitive species in the Sacramento River basin. Water supply modeling and temperature analyses should be conducted to identify conflicting requirements to achieve both flow and cold water temperature goals.

5.3 San Joaquin River

Following are the San Joaquin River inflow criteria based on analysis of the species-specific flow criteria and other measures:

1) San Joaquin River at Vernalis: 60%of 14-day average unimpaired flow from February through June
2) San Joaquin River at Vernalis: 10 day minimum pulse of 3,600 cfs in late October
3) San Joaquin River at Vernalis: 2006 Bay-Delta Plan flow objective for October

San Joaquin River inflow criterion 1 and 2 are Category A criteria because they are supported by sufficiently robust scientific information. The 2006 Bay-Delta Plan San Joaquin River inflow objective for October is included as a Category B criterion because it is not clear that eliminating this criterion in lieu of criteria 2 would provide adequate protection to migrating adult Chinook salmon. Following is discussion and rationale for these criteria. Category A and B criteria are both equally important for protection of the public trust resource, but there is more uncertainty about the appropriate volume of flow required to achieve the goals of the Category B criterion. Following is discussion and rationale for these criteria.

As discussed in the Sacramento River inflow section, the magnitude, duration, timing, and source of San Joaquin River inflows are important to Chinook salmon migrating through the Bay-Delta and several different aspects of their life history. Inflows are needed to provide appropriate conditions to cue upstream adult migration to the San Joaquin River and its tributaries, adult holding, egg incubation, juvenile rearing, emigration from the San Joaquin River and its tributaries, and other functions. San Joaquin River inflows are important for much of the year to support various life stages of San Joaquin basin fall-run Chinook salmon (and spring-run when they are reintroduced). However, given the focus of this proceeding on inflows to the Delta and the lack of information received concerning spring-run flow needs on the San Joaquin River, the San Joaquin River inflow criteria included in this report focus on flows needed to support migrating fall-run Chinook salmon from and to natal streams through the Delta. Following is a brief summary of the San Joaquin River inflow criteria that were developed based on the species-specific flow needs analyses for salmon included in section 4.2.3 followed by a detailed discussion.

Available scientific information indicates that average March through June flows of 5,000 cfs on the San Joaquin River at Vernalis represent a flow threshold at which survival of juveniles and subsequent adult abundance is substantially improved for fall-run Chinook salmon and that average flows of 10,000 cfs during this period may provide conditions necessary to achieve doubling of San Joaquin basin fall-run. Both the AFRP and DFG flow recommendations to achieve doubling also seem to support these general levels of flow, though the time periods are somewhat different (AFRP is for February through May and DFG is for March 15 through June 15). Available information also indicates that flows of 3,000 to 3,600 cfs for 10 to 14 days are needed during mid to late October to reduce straying, improve olfactory homing fidelity, and improve gamete viability for San Joaquin basin returning adult Chinook salmon.

Continuity of flows from natal stream through the Delta and flow variability are also important, so rather than advancing static flow criteria for the spring period to support emigration of juvenile San Joaquin basin fall-run Chinook salmon, the State Water Board

determines, as a Category A criterion, that 60% of unimpaired flow from February through June is needed in order to achieve a threshold flow of 5,000 cfs or more in most years (over 85% of years) and flows of 10,000 cfs slightly less than half of the time (45% of years). Given that the focus of this proceeding is on protection of public trust resources, the State Water Board determines that the time period for these flows should be extended to cover all three periods supported by the DFG, AFRP, and TBI/NRDC analyses concerning flow needs. In addition, the State Water Board determines, as a Category A criterion, that flows of 3,600 cfs are needed for 10 days in late October. These flows could also be provided in a manner that better reflects the natural hydrograph to coincide with natural storm events. Until additional information is developed, maintaining the October pulse flow called for in the 2006 Bay-Delta Plan is also determined to be a Category B criterion to assure that the existing protection provided during this period is not diminished. All of the San Joaquin River flow criteria are not precise; rather they reflect the general timing and magnitude of flows needed to protect public trust resources, but could serve as a reasonable basis from which future analysis and adaptive management could proceed. The criteria also do not consider other San Joaquin River flow needs.

San Joaquin River Inflows as a Percentage of Unimpaired Flow During the Spring

As discussed in the Sacramento River inflow section, it is important to preserve the general attributes of the natural hydrograph to which the various salmon runs adapted to over time, including variations in flows and continuity of flows. Accordingly, as with the Sacramento River flow criteria, the State Water Board developed flow criteria for San Joaquin River inflows to protect emigrating juvenile Chinook salmon intended to mimic the natural hydrograph during the peak emigration period of February through June. This period may also cover a portion of the rearing period for juveniles as well. As with the Sacramento River flow criteria, to achieve the attributes of a natural hydrograph, the criteria are advanced as a percentage of unimpaired flow on a 14-day average, to be achieved on a proportional basis from the tributaries to the San Joaquin River. The unimpaired estimates from which the 60% criterion is calculated are monthly estimates. Estimates of 14-day unimpaired flow have not been published, but the exceedance curve is likely similar to one generated with monthly estimates. The appropriateness of this time-step and the percentage of unimpaired flows should be further evaluated.

To determine the percentage of unimpaired flow needed to protect Chinook salmon, the State Water Board reviewed flow exceedance information to determine what percentage of flow would be needed to achieve various flows. The analysis in section 4.2.3 indicates that increasing spring flows on the San Joaquin River and its tributaries is needed to protect Chinook salmon in the San Joaquin River basin. The TBI/NRDC analyses of temperatures and population growth indicate that there is a threshold response for fall-run Chinook salmon survival to flows above 5,000 cfs during the spring period and that average flows of 10,000 cfs during this same period may provide adequate flows to achieve doubling. Both the AFRP and DFG modeling analyses also seem to support these flows. However, the time periods for the AFRP recommended flows is from February through May and the time period for the DFG recommended flows is from March 15 through June 15. AFRP, DFG, and TBI/NRDC provide different recommendations for how to distribute flows during the spring period in different years, with increasing flows in increasingly wet years. All are generally consistent with an approach that mimics the natural flow regime to which these fish were adapted. Other analyses speak to the validity of this approach. (Propst and Gido, 2004 and Marchetti and Moyle, 2001, as cited in DOI 1, p. 25.) San Joaquin River flow criteria for the

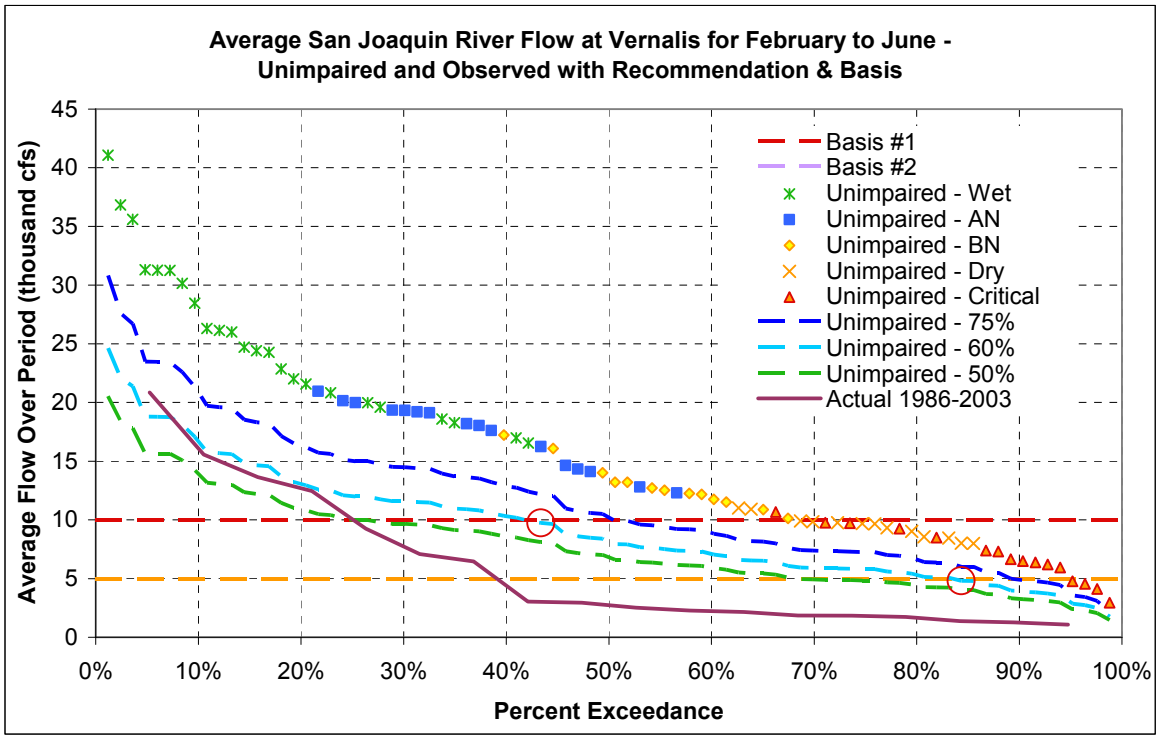
February through June period are determined to be 60% of unimpaired flows. Figure 20b shows that if 60% of unimpaired San Joaquin River flow at Vernalis were provided, average March through June flows would meet or exceed 5,000 cfs in over 85% of years (shown by red circle). An unimpaired flow of 60% during this period would also meet or exceed 10,000 cfs during the March through June time period in approximately 45% of years. The exceedance rates are not significantly different if applied to the February through June period as shown in Figure 20a. Additional information should be developed to determine whether these flows could be lower or higher and still meet the Chinook salmon doubling goal in the long term.

San Joaquin River Fall Flows

In addition to spring flows, fall pulse flows on the San Joaquin River are needed to provide adequate temperature and DO conditions for adult salmon upstream migration, to reduce straying, improve gamete viability, and improve olfactory homing fidelity for San Joaquin basin salmon. Analyses support a range of flows from 3,000 to 3,600 cfs for 10 to 14 days during mid to late October. Absent additional information, the State Water Board determines flow criteria for late fall to be 3,600 cfs for a minimum of 10 days in mid to late October. Providing these flows from the tributaries to the San Joaquin River that support fall-run Chinook salmon appears to be a critical factor to achieve homing fidelity and continuity of flows from the tributaries to the mainstem and Delta. Until additional information is developed regarding the need to maintain the 2006 Bay-Delta Plan October flow objective, these flows supplement and do not replace the 2006 Bay-Delta Plan October flow requirements such that flows do not drop below historic conditions during the remainder of October when the pulse flow criteria would not apply. Additional analyses should be conducted to determine the need to expand the pulse flow time period and modify the criteria to better mimic the natural hydrograph by coinciding pulse flows with natural storm events in order to potentially improve protection by mimicking the natural hydrograph.

Given that salmon and steelhead may be present in the San Joaquin River and its tributaries for all or most of the year (including spring-run in the future) and that the Bay-Delta plan does not currently include any flow requirements from July through September and November through January, additional flow criteria for the remainder of the year may be needed to protect Chinook salmon and their habitat. Specifically, additional criteria for spawning, egg incubation, rearing and riparian vegetation recruitment may be needed. However, adequate information is not available in the record for this proceeding upon which to base such criteria at this time. Additional information, building on the AFRP and other analyses, should be developed to determine needed flows for the remainder of the year.

a)



b)

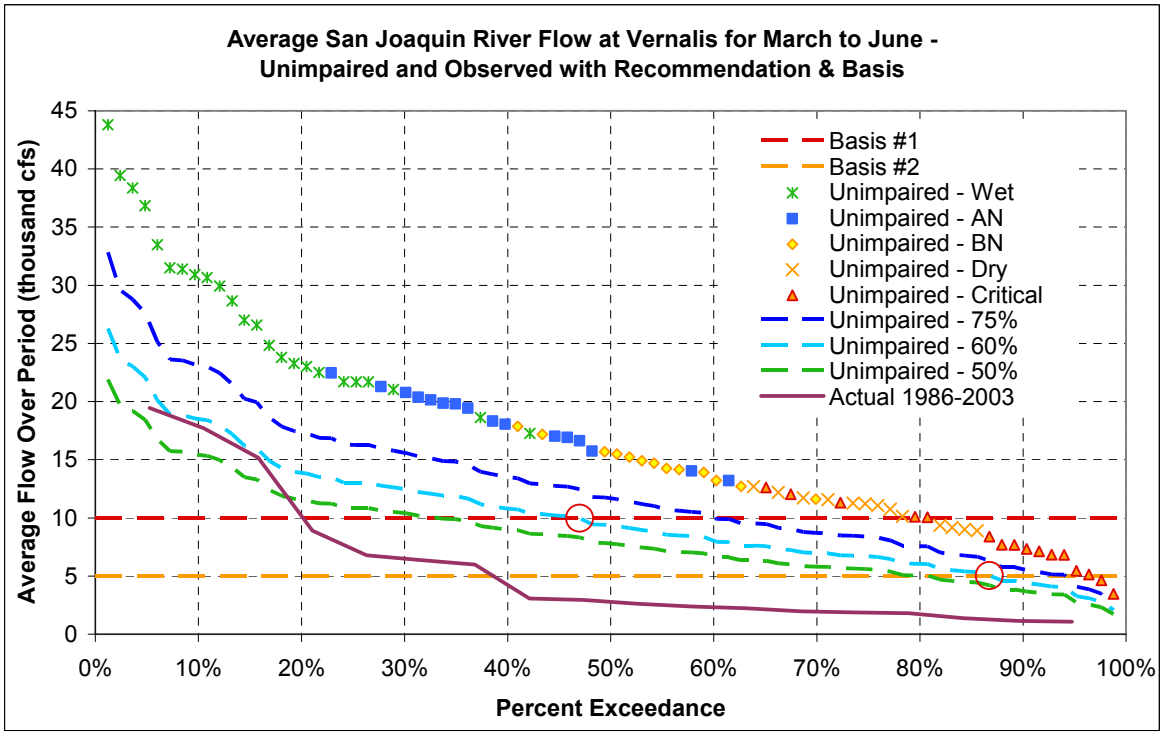


Figure 20. San Joaquin River Flow Exceedance Plot - February through June

The specific San Joaquin River flow criteria may need to be tempered by the need to maintain water in reservoirs to provide adequate cold water and tributary specific flows in the San Joaquin River basin. It may not be possible to attain both the flow criteria and meet the thermal and tributary specific flow needs of steelhead, fall-run Chinook salmon, and other sensitive species in the San Joaquin River basin. Water supply modeling and temperature analyses should be conducted to identify conflicting requirements to achieve both flow and cold water temperature goals.

5.4 Hydrodynamics

The following hydrodynamic related criteria have been developed based on analysis of the species-specific flow criteria and other measures discussed above:

1) San Joaquin River Flow to Export Ratio: Vernalis flows to exports great than .33 during the 10 day San Joaquin River pulse flow in October
2) Old and Middle River Flows: greater than -1,500 cfs in March and June of Critical and Dry water years
3) Old and Middle River Flows: greater than 0 or -1,500 cfs in April and May of Critical and Dry water years, when FMWT index for longfin smelt is less than 500, or greater than 500, respectively
4) Old and Middle River Flows: greater than -5,000 cfs from December through February in all water year types
5) Old and Middle River Flows: greater than -2,500 when salmon smolts are determined to be present in the Delta from November through June
6) San Joaquin River Flow to export Ratio: Vernalis flow to exports greater than 4.0 when juvenile San Joaquin River salmon are migrating in the mainstem San Joaquin River from March through June
7) San Joaquin River at Jersey Point Flows: Positive flows when salmon are present in the Delta from November through June
8) 2006 Bay-Delta Plan Exports to Delta Inflow Limits for the Entire Year

Hydrodynamic criteria 1 is a Category A criterion because it is supported by more robust scientific information. Hydrodynamic criteria 2-7 are Category B criteria because there is less scientific information, with more uncertainty, to support the specific numeric criteria. The 2006 Bay-Delta Plan exports to Delta inflow objective (criteria 8) is offered as a Category B criterion as a minimal level of protection when the other criteria above do not apply. However, the validity of the specific export restrictions included in the 2006 Bay-Delta Plan were not specifically reevaluated. Category A and B criteria are both equally important for protection of the public trust resource, but there is more uncertainty about the appropriate volume of flow required to achieve the goals of the Category B criteria. Following is discussion and rationale for these criteria.

<u>Pelagic Species Criteria</u>

Net OMR reverse flows have increased in both magnitude and frequency with the development of the California water projects (Figure 8) and are having a detrimental effect on biotic resources in the Delta. (Brown et al. 1996.) It is also clear that the negative impact of net OMR reverse flows increases as Sacramento River inflows and net Delta outflow decreases. (Grimaldo et al. 2009; Kimmerer 2008; USFWS 2008; NMFS, 2009.) Net OMR flow restrictions for the protection of longfin and Delta smelt are only recommended for dry and critically dry water years when less Delta outflow may be available (Table 23, criteria 2 and 3). No spring restrictions for the protection of longfin

and delta smelt are proposed for other water year types if the higher net Delta outflow criteria are met. If higher outflows are not provided in wetter years, then restrictions on OMR may be needed in these years as well. The State Water Board determines that net OMR flow criteria of greater than -5,000 cfs, from December through February in all water year types, to protect upstream migrating adult smelt are needed. The -5,000 cfs criterion may need to be made more protective if a large portion of the smelt population moves into the central Delta. The additional restrictions would be recommended after consultation with the USFWS (2008) Smelt Working Group. Spring and winter net OMR flow criteria for the protection of longfin and Delta smelt are classified as Category B because, as noted by the NAS (2010),

> " the data do not permit a confident identification of the threshold [OMR] values to use and do not permit a confident assessment of the benefits to the population As a result, the implementation of this action needs to be accompanied by careful monitoring, adaptive management and additional analyses that permit regular review and adjustment of strategies as knowledge improves "

Chinook Salmon Criteria

Salmon must migrate through the Delta past the effects of the south Delta export facilities and the associated inhospitable conditions in the central Delta, first as juveniles on their way to the ocean, and later as adults returning to spawn. Exports change the hydrodynamic patterns in the Delta, drawing water across the Delta rather than allowing water to flow out of the Delta in a natural pattern. Over the years, different criteria have been developed to attempt to protect migrating salmon from the adverse hydrodynamic conditions caused by the south Delta export facilities in order to preserve the functional flows needed for migration that could be used to protect public trust resources. Net OMR flows, Jersey Point flows, and Vernalis flow to export ratios are all criteria that can be used to protect migrating salmon. The State Water Board advances a combination of these criteria to protect migrating salmon from export effects.

Increasingly negative net OMR flows have been shown to increase particle entrainment, particularly beginning at flows between -2,500 and -3,500 cfs. While juvenile salmon do not necessarily behave like particles, the particle entrainment estimates are a useful guide until additional information can be developed using evolving acoustic tracking methods and other appropriate techniques. Reduced negative net OMR flows should also provide some level of protection from the indirect reverse flow effects related to fish entering the central Delta where predation and other sources of mortality are higher. Based on the above, the State Water Board determines criteria for net OMR flows should be for greater than -2,500 cfs when salmon are present in the Delta during the peak juvenile outmigration period of November through June, for the protection of Chinook salmon. This is a Category B criterion because there is limited information upon which to base a specific numeric criteria at this time. Such information should be developed to better understand the relationship between salmon survival and net OMR flows to determine more specific criteria that would protect against entrainment and other factors leading to indirect mortality.

Increased reverse flows at Jersey Point have also been shown to decrease survival of salmon smolts migrating through the lower San Joaquin River. However, the precise Jersey Point flow that is necessary to protect migrating salmon is unclear. In addition, it is unclear whether the same functions of such a flow could be better met using different

criteria such as net OMR flows or San Joaquin River flow to export ratios. The State Water Board therefore advances positive Jersey Point flows when salmon are present in the Delta during the peak juvenile salmon outmigration period of November through June. Again, this is a Category B criterion because there is limited information upon which to base a specific numeric criteria at this time.

Increased San Joaquin River flow to export ratios appear to improve survival for San Joaquin River salmon, though the exact ratio that is needed to protect public trust resources is not well understood. A San Joaquin River flow to export ratio of greater than 4.0 is recommended as a Category B criterion when San Joaquin River juvenile salmon are outmigrating from the San Joaquin River from March through June. There is, however, sufficient information in the record to support a Category A criterion for exports to be kept to less than 300% of San Joaquin River flows (equal to a San Joaquin River flow to export ratio of more than 0.33) at the same time that the recommended San Joaquin River pulse flows are provided. Additional analyses should be conducted to determine if this time frame should be extended to capture more of the San Joaquin River adult Chinook salmon return period between October and January.

The NAS review concerning OMR restrictions for salmon concluded that:

> " the strategy of limiting net tidal flows toward the pump facilities is sound, but the support for the specific flows targets is less certain. In the near-term telemetry-based smolt migration and survival studies (e.g, Perry and Skalski, 2009) should be used to improve our understanding of smolt responses to OMR flow levels." (NAS 2010, p. 44.)

Much additional work is needed to better understand the magnitude and timing of the recommended criteria and how net OMR flow criteria should be integrated with other criteria for San Joaquin River flows, San Joaquin River flows to export ratios, Sacramento River flows, and net OMR flow restrictions for the protection of pelagic species. For all of the OMR, Jersey Point, and Vernalis flows to export ratiocriteria, further analysis and consideration is needed to determine: 1) how salmon presence should be measured and the information used to temper the criteria; 2) an appropriate averaging period; and 3) how to adaptively manage to assure that flows are sufficiently, but not overly, protective.

The October San Joaquin River flow to export ratio criteria is a Category A criterion since the basis for this minimum criterion is sufficiently understood to develop a quantitative criteria. Additional analyses should still, however, be conducted to determine if this criteria could be refined to provide better protection for migrating adult San Joaquin River Chinook salmon. All of the other hydrodynamic criteria for the protection of Chinook salmon are Category B criteria.

The San Joaquin River flow to export criterion during the spring is also a Category B criterion due to a lack of certainty regarding the needed protection level. Regarding this issue, the NAS concluded that:

> " the rationale for increasing San Joaquin River flows has a stronger foundation than the prescribed action of concurrently managing inflows and exports. We further conclude that the implementation of the 6-year steelhead smolt survival study (action IV.2.2) could provide useful insight

> as to the actual effectiveness of the proposed flow management actions as a long-term solution." (NAS 2010, p. 45.)

In addition, based on similar uncertainty regarding needed protection levels and interaction between net OMR flows and San Joaquin River flows to export ratios, the San Joaquin River at Jersey Point criterion is also a Category B criterion. More work is needed to develop a suite of operational tools and an operational strategy for applying those tools to protect public trust resources in the Delta from the adverse hydrodynamic effects of water diversions, channel configurations, reduced flows, and other effects.

2006 Bay-Delta Plan Export Objectives

The 2006 Bay-Delta Plan includes export limitations for the entire year. From February through June exports are limited to 35-45% of Delta inflow. (State Water Board 2006a, pp. 184-187.) From July through January, exports are limited to 65% of Delta inflow. (*Id.)* The export to Delta inflow restrictions are intended to protect the habitat of estuarine-dependent species. (State Water Board 2006b, pp. 46-47.) These export restrictions provide a minimum level of protection for public trust uses and should be maintained to the extent that the other recommended criteria do not override them.

For all of the hydrodynamic criteria, biologically appropriate averaging periods need to be developed. Averaging periods may need to include a two-step approach whereby a shorter averaging period is included that allows for some divergence from the criteria and a longer averaging period is included that does not.

5.5 Other Inflows - Eastside Rivers and Streams

The Cosumnes and Mokelumne rivers, and smaller streams such as the Calaveras River, Bear Creek, Dry Creek, Stockton Diversion Channel, French Camp Slough, Marsh Creek, and Morrison Creek are all tributary to the Delta. Flows should generally be provided from tributaries in proportion to their contribution to unimpaired flow.

5.6 Other Measures

5.6.1 Variability, Flow Paths, and the Hydrograph

Criteria should reflect the frequency, duration, timing, and rate of change of flows, and not just volumes or magnitudes. Accordingly, whenever possible, the criteria specified herein are expressed as a percentage of the unimpaired flow rather than as a single number or range of numbers that vary by water year type. Additional efforts should focus on restoring habitat complexity. Inflows should generally be provided from tributaries to the Delta watershed in proportion to their contribution to unimpaired flow in order to assure connection between Delta flows and upstream tributaries, to the extent that such connections are beneficial to protecting public trust resources. Flows should be at levels that maintain flow paths and positive salinity gradients through the Delta. This concept is reflected in the specific determinations made above. More study is needed to determine to which tributaries such criteria should apply. For example, since the percent of unimpaired flow criteria determined to protect public trust uses for San Joaquin River inflows is at times lower than the criteria determined for Delta outflow, more study is needed to determine the appropriate source of such flows to protect public trust resources. All determined flow criteria must also be tempered by the need to protect health and safety. No flow criteria, for example, should be in excess of flows that would lead to flooding. For all of the flow criteria, there may be a need to reshape the

specified flows to better protect public trust resources based on real-time considerations. All of the criteria should be implemented adaptively to allow for such appropriate reshaping to improve biological and geomorphological processes.

Moyle *et al* (2010) concluded, however, that there is a fundamental conflict between restoring variability and maintaining the current Delta:

> "restoring environmental variability in the Delta is fundamentally inconsistent with continuing to move large volumes of water through the Delta for export. The drinking and agricultural water quality requirements of through-Delta exports, and perhaps even some current in-Delta uses, are at odds with the water quality and variability needs of desirable Delta species."

5.6.2 Floodplain Activation and Other Habitat Improvements

Activated floodplains stimulate food web activity and provide spawning and rearing habitat for floodplain adapted fish. The frequency of low-magnitude floods that occurred historically has been reduced, primarily by low water control levees. The record supports the conclusion that topography changes associated with future floodplain restoration will provide improved ecosystem function with less water. Studies and demonstration projects for, and implementation of, floodplain restoration projects should therefore proceed to allow for the possible reduction of flows required to protect public trust resources in the Delta.

Floodplain Flow Determinations for Protection of Salmon and Splittail:
Floodplain and off-channel inundation are required for splittail spawning and appear to be important in protecting Chinook salmon. At the same time, it is also important how and when such inundation occurs. Due to the effects of levees and dams, natural side channel and floodplain inundating flows have been substantially reduced. As a result, modification to weirs and other changes may be needed to substantially improve floodplain inundation conditions on the Sacramento and San Joaquin rivers. Based on the above, the State Water Board determines that an effort be made to provide appropriate additional seasonal floodplain habitat for salmon, splittail, and other species in the Central Valley. The various recommendations the State Water Board received for floodplain inundation are included in Appendix A.1. The State Water Board has no specific flow determinations for floodplain inundation. The State Water Board recommends that BDCP, the Council, and others continue to explore the various issues concerning flood protection, weir modifications, and property rights related to floodplain inundation.

Other future habitat improvements will likely change the response of native fishes to flow and allow flow criteria to be modified. Habitat restoration should proceed to allow for the possible reduction of flows required to protect public trust resources in the Delta. Other future habitat restoration that should be reviewed and implemented include:

- Development of slough networks with natural channel geometry and less diked and rip-rapped channel habitat
- Increased tidal marsh habitat, including shallow (one to two meters) subtidal areas in both fresh and brackish zones of the estuary (in Suisun Marsh, for example)

- Create large expanses of low salinity open water habitat in the Delta

5.6.3 Water Quality and Contaminants

Any set of flow criteria should include the capacity to readily adjust the flows to adapt to changing future conditions and improved understanding. (DEFG 1.) As our understanding of the effect of contaminants on primary production and species composition in the Sacramento River and Delta improves, flow criteria may need to be revisited.

The Central Valley and San Francisco Regional Water Boards should continue developing Total Maximum Daily Loads (TMDLs) for all listed pollutants and adopting programs to implement control actions. Specifically, the Central Valley Regional Board should require additional studies and incorporate discharge limits and other controls into permits, as appropriate, for the control of nutrients, including ammonia.

5.6.4 Coldwater Pool Resources and Instream Flow Needs on Tributaries

The flow criteria contained in this report should be tempered by the need to maintain cold water resources and meet tributary specific flow needs in the Delta watershed. It may not be possible to attain all of the identified flow criteria in all years and meet the tributary flow needs and thermal needs of the various runs of Chinook salmon, steelhead, and other sensitive species. Temperature and water supply modeling analyses should be conducted to identify conflicting requirements to achieve both flow and cold water temperature goals. In addition, these flow determinations do not consider the needs of other non-fish species and terrestrial species which should be considered before any implementation of these criteria.

5.6.5 Adaptive Management

The numeric criteria are all short term criteria that are only appropriate for the current physical system and climate. There is uncertainty in these criteria even for the current physical system and climate, and therefore for the short term. Long term numeric criteria, beyond five years, for example, and assuming a modified physical system, are highly speculative. Only the underlying principles for the proposed numeric criteria and the other measures are advanced as long term determinations.

The information received in this proceeding suggests that the relationships between hydrology, hydrodynamics, water quality, and the abundance of desirable species are often unclear. In preparing for the long term, resources should be directed toward better understanding these relationships. In particular, there is significant uncertainty associated with Category B numeric criteria advcanced in this report. Category B criteria should therefore be high priority candidates for grant funded research.

A strong science program and a flexible management regime are critical to improving flow criteria. The relationship between flow, habitat, and abundance is not well enough understood to recommend flows in the Delta ecosystem without some reliance on adaptive management to better manage these flows. The State Water Board intends to work with the Council, the Delta Science Program, IEP, and others to develop the framework for adaptive management that could be relied upon for the management and regulation of flows in the Delta. The State Water Board will consider supporting and incorporating into its regulations greater reliance upon adaptive management in its flow regulations.

5.7 Summary Determinations

Table 20 through Table 23 provide summary determinations for Delta outflows, Sacramento inflows, San Joaquin River inflows, and hydrodynamics, respectively. Each table shows various numbered criteria, applicable to the shaded range of months. Criteria fall into two categories. Category "A" criteria have more robust scientific information to support specific numeric criteria than do Category "B" criteria. Both categories of criteria are considered equally important for protection of public trust resources in the Delta ecosystem, and are supported by scientific information on function-based species or ecosystem needs. The basis and explanation for each criterion is provided. Each table is appended with the following notes to explain the limitations and constraints of how the criteria should be considered:

- All flows are subject to appropriate ramping rates to avoid ramping impacts to public trust resources
- These flow criteria should be tempered by tributary specific flow needs and the need to manage cold-water resources for the protection of public trust resources
- Criteria for percentages of unimpaired flows apply only up to a specified maximum cap; appropriate maximum flow caps still need to be determined based on public trust needs and to avoid flooding.
- Additional flows may be needed for the protection of public trust resources for periods of time for which no flow criteria have been determined or where Bay-Delta Plan flow objectives are advanced, but adequate information is not available at this time to determine such flows

These criteria are made specifically to achieve the stated goal of halting the population decline and increase populations of native species as well as species of commercial and recreational importance. Additionally, positive changes in the Delta ecosystem resulting from improved flow or flow patterns will benefit humans as well as fish and wildlife, especially when accompanied by large-scale habitat restoration and pollution reduction. (Moyle *et al*, 2010.)

In addition, Table 24 contains a summary of other issues and concepts that should be considered in conjunction with the numeric criteria. These other measures are also based on a synthesis of the best scientific information submitted by participants in the State Water Board's Informational Proceeding. These criteria and other measures, however, must be further qualified as to their limitations. The limitations of this and any other flow prescription are described at the end of the Fleenor *et al*. (2010) "flow prescriptions" report as a "further note of caution":

> "How much water do fish need?" has been a common refrain in Delta water management for many years it is highly unlikely that any fixed or predetermined prescription will be a "silver bullet". The performance of native and desirable fish populations in the Delta requires much more than fresh water flows. Fish need enough water of appropriate quality over the temporal and spatial extent of habitats to which they adapted their life history strategies. Typically, this requires habitat having a particular range of physical characteristics, appropriate variability, adequate food supply and a diminished set of invasive species. While folks ask "How much water do fish need?" they might well also ask, "How much habitat of different types and locations, suitable water quality,

> improved food supply and fewer invasive species that is maintained by better governance institutions, competent implementation and directed research do fish need?" The answers to these questions are interdependent. We cannot know all of this now, perhaps ever, but we do know things that should help us move in a better direction, especially the urgency for being proactive. We do know that current policies have been disastrous for desirable fish. It took over a century to change the Delta's ecosystem to a less desirable state; it will take many decades to put it back together again with a different physical, biological, economic, and institutional environment."

The State Water Board concurs with this cautionary note and recommends the flow criteria and other conclusions advanced in this report be used to inform the planning efforts for the Delta Plan and BDCP and as a report that can be used to guide needed research by the Delta Science Program and other research institutions.

Table 20. Delta Outflow Summary Criteria

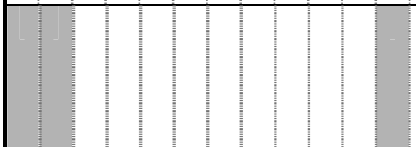
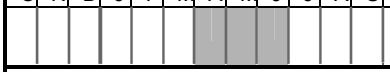
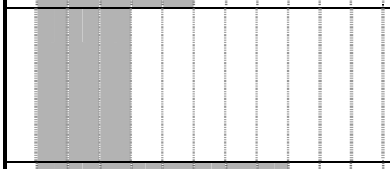
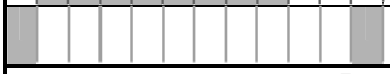
Delta Outflows	
Category A	
Water Year O N D J F M A M J J A S	**Criteria**
	1) Net Delta Outflows: 75% of 14-day average unimpaired flow
Category B	
Water Year O N D J F M A M J J A S	**Criteria**
	2) Fall X2 a. Wet years: X2 less than 74 km (greater than approximately 12,400 cfs) b. Above normal years: X2 less than 81 km (greater than approximately 7,100 cfs)
	3) Net Delta Outflows: 2006 Bay-Delta Plan Delta Outflow Objectives - applies during critical, dry, and below normal years
Basis for Criteria and Explanation	
1) Promote increased abundance and improved productivity (positive population growth) for longfin smelt and other desirable estuarine species 2) Increase quantity and quality of habitat for delta smelt; fall X2 requirement limited to above normal and wet years to reduce potential conflicts with cold water pool storage, while promoting variability with respect to fall flows and habitat conditions in above normal and wet water year types; expected to result in improved conditions for delta smelt, however, the statistical relationship between fall X2 and abundance is not strong; note 2) above regarding need for improved understanding concerning the fall X2 action also applies 3) Fish and wildlife beneficial use protection Notes: • These flow criteria do not consider any balancing of public trust resource protection with public interest needs for water. • All flows are subject to appropriate ramping rates to avoid ramping impacts to public trust resources. • These flow criteria should be tempered by tributary specific flow needs and the need to manage cold-water resources for the protection of public trust resources. • Criteria for percentages of unimpaired flows apply only up to a specified maximum cap; appropriate maximum flow caps still need to be determined based on public trust needs and to avoid flooding. • Additional flows may be needed for the protection of public trust resources for periods of time for which no flow criteria are recommended or where 2006 Bay-Delta Plan flow objectives are recommended, but adequate information is not available at this time to recommend such flows.	

Table 21. Sacramento River Inflow Summary Criteria

Sacramento River Inflows	
Category A	
Water Year O N D J F M A M J J A S	**Criteria**
	1) Rio Vista: 75% of 14-day average unimpaired flow[1]
Category B	
Water Year O N D J F M A M J J A S	**Criteria**
	2) Rio Vista: 75% of 14-day average unimpaired flow to support same functions as #1 for other runs of Chinook salmon
	3) Wilkins Slough: Provide pulse flows of 20,000 cfs for 7 days starting in November coinciding with storm events producing unimpaired flows at Wilkins Slough above 20,000 cfs until monitoring indicates that majority of smolts have moved downstream[2]
	4) Freeport: Positive flows in Sacramento River downstream of confluence with Georgiana Slough while juvenile salmon are present (approximately 13,000 to 17,000 cfs)
	5) Rio Vista: 2006 Bay-Delta Plan flow objectives
Basis for Criteria and Explanation, and Notes	

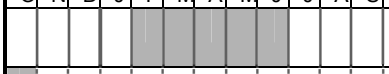
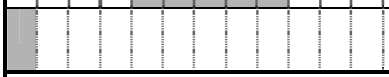
1) Increase juvenile salmon outmigration survival and abundance for fall-run Chinook salmon
2) Promote juvenile salmon emigration for other runs of Chinook salmon
3) Increase juvenile salmon outmigration survival by reducing diversion into Georgiana Slough and the central Delta
4) Increases juvenile salmon outmigration survival
5) Fall adult Chinook salmon attraction flows

Notes:

- These flow criteria do not consider any balancing of public trust resource protection with public interest needs for water.
- All flows are subject to appropriate ramping rates to avoid ramping impacts to public trust resources.
- These flow critiera should be tempered by tributary specific flow needs and the need to manage cold-water resources for the protection of public trust resources.
- Criteria for percentages of unimpaired flows apply only up to a specified maximum cap; appropriate maximum flow caps still need to be determined based on public trust needs and to avoid flooding.
- Additional flows may be needed for the protection of public trust resources for periods of time for which no flow criteria are recommended or where 2006 Bay-Delta Plan flow objectives are recommended, but adequate information is not available at this time to recommend such flows.

[1] 75% of unimpaired flow at Freeport applied to Rio Vista
[2] Definition of storm, number of storms, and how to determine when the majority of juveniles have outmigrated needs to be determined.

Table 22. San Joaquin River Inflow Summary Criteria

San Joaquin River Inflows	
Category A	
Water Year O N D J F M A M J J A S	**Criteria**
	1) Vernalis: 60% of 14-day average unimpaired flow
	2) Vernalis: 10 day minimum pulse flow of 3,600 cfs in late October (e.g., October 15 to 26)
Category B	
Water Year O N D J F M A M J J A S	**Criteria**
	3) Vernaisl: 2006 Bay-Delta Plan October flows
Basis for Criteria and Explanation, and Notes	

1) Increase juvenile Chinook salmon outmigration survival and abundance and provide conditions that will generally produce positive population growth in most years and achieve the doubling goal in more than half of years
2) Minimum adult Chinook salmon attraction flows to decrease straying, increase DO, reduce temperatures, and improve olfactory homing fidelity
3) Adult Chinook salmon attraction flows

Notes:

- These flow criteria do not consider any balancing of public trust resource protection with public interest needs for water.
- All flows are subject to appropriate ramping rates to avoid ramping impacts to public trust resources.
- These flow criteria should be tempered by tributary specific flow needs and the need to manage cold-water resources for the protection of public trust resources.
- Criteria for percentages of unimpaired flows apply only up to a specified maximum cap; appropriate maximum flow caps still need to be determined based on public trust needs and to avoid flooding.
- Additional flows may be needed for the protection of public trust resources for periods of time for which no flow criteria are recommended or where 2006 Bay-Delta Plan flow objectives are recommended, but adequate information is not available at this time to recommend such flows.

Table 23. Hydrodynamics Summary Criteria

Hydrodynamics: Net OMR, Inflow-Export Ratios, and Jersey Point	
Category A	
Water Year (O N D J F M A M J J A S)	**Criteria**
	1) San Joaquin River Flow to Export Ratio: Vernalis flows to exports greater than 0.33 during fall pulse flow (e.g., October 15 – 26); complementary action to San Joaquin River inflow critieria #2
Category B	
Water Year (O N D J F M A M J J A S)	**Criteria**
	2) Net OMR Flows: greater than -1,500 cfs in Critical and Dry water years
	3) Net OMR Flows: greater than 0 or -1,500 cfs in Critical and Dry water years, when FMWT index for longfin smelt is less than 500, or greater than 500, respectively
	4) Net OMR Flows: greater than -5,000 cfs in all water year types
	5) Net OMR Flows: greater than -2,500 cfs when salmon smolts are determined to be present in the Delta
	6) San Joaquin River Flow to Export Ratio: Vernalis flows to exports greater than 4.0 when juvenile San Joaquin River salmon are migrating in mainstem San Joaquin River
	7) Jersey Point: Positive flows when salmon present in the Delta
	8) Exports to Delta Inflows: 2006 Bay-Delta Plan exports to inflows restrictions
Basis for Criteria and Explanation	

1) Reduce straying and improve homing fidelity for San Joaquin basin adult salmon
2) Reduce entrainment of larval / juvenile delta smelt, longfin smelt, and provide benefits to other desirable species
3) Same as number 2), but if the previous FMWT index for longfin smelt is less than 500, then OMR must be greater than 0 (to reduce entrainment losses when abundance is low), or greater than -1,500 if the previous FMWT index for longfin smelt is greater than 500
4) Reduce entrainment of adult delta smelt, longfin smelt, and other species; less negative flows may be warranted during periods when significant portions of the adult smelt population migrate into the south or central Delta; thresholds for such flows need to be determined
5) Reduce risk of juvenile salmon entrainment and straying to central Delta at times when juveniles are present in the Delta; will also provide associated benefits for adult migration
6) Improve survival of San Joaquin River juvenile salmon emigrating down the San Joaquin River and improve subsequent escapement 2.5 years later
7) Increase survival of outmigrating smolts, decrease diversion of smolts into central Delta where survival is low, and provide attraction flows for adult returns
8) Protection of estuarine dependent species

(cont.)

Notes:

- These flow criteria do not consider any balancing of public trust resource protection with public interest needs for water.
- All flows are subject to appropriate ramping rates to avoid ramping impacts to public trust resources.
- These flow critieria should be tempered by tributary specific flow needs and the need to manage cold-water resources for the protection of public trust resources.
- Criteria for percentages of unimpaired flows apply only up to a specified maximum cap; appropriate maximum flow caps still need to be determined based on public trust needs and to avoid flooding.
- Additional flows may be needed for the protection of public trust resources for periods of time for which no flow criteria are recommended or where 2006 Bay-Delta Plan flow objectives are recommended, but adequate information is not available at this time to recommend such flows.

Table 24. Other Summary Determinations

Variability and the Natural Hydrograph:

- Criteria should reflect the frequency, duration, timing, and rate of change of flows, and not just volumes or magnitudes. Accordingly, whenever possible, the criteria specified above are expressed as a percentage of the unimpaired hydrograph.
- Inflows should generally be provided from tributaries to the Delta watershed in proportion to their contribution to unimpaired flow unless otherwise indicated. This concept is reflected in the specific criteria above.

Floodplain Activation and Other Habitat Improvements:

- Studies and demonstration projects for, and implementation of, floodplain restoration, improved connectivity and passage, and other habitat improvements should proceed to provide additional protection of public trust uses and potentially allow for the reduction of flows otherwise needed to protect public trust resources in the Delta.

Water Quality and Contaminants:

- The Central Valley and San Francisco Regional Water Boards should continue developing TMDLs for all listed pollutants and adopting programs to implement control actions.
- The Central Valley Regional Board should require additional studies and incorporate discharge limits and other controls into permits, as appropriate, for the control of nutrients and ammonia.

Coldwater Pool Resources and Instream Flow Needs on Tributaries:

- Temperature and water supply modeling and analyses should be conducted to identify conflicting requirements to achieve both flow and cold water temperature goals.

Adaptive Management:

- A strong science program and a flexible management regime are critical to improving flow criteria. The State Water Board should work with the Council, the Delta Science Program, IEP, and others to develop the framework for adaptive management that could be relied upon for the management and regulation of Delta flows.
- The numeric criteria in this report are all short term criteria that are only appropriate for the current physical system and climate; actual flows should be informed by adaptive management
- Only the underlying principles for the numeric criteria and these other measures are advanced as long termcriteria.

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7. Appendices

Appendix A: Summary of Participant Recommendations

Appendix A, Table 1. Delta outflow recommendations summary table (cfs unless otherwise noted).

	Water Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Source / Note
Unimpaired Flow 1956-2003	C	16092	23292	31045	29103	27552	15301	5974	3880	4096	8167	8372	12531	
	D	24670	37460	52907	45810	39512	18994	6801	4759	5180	7221	16635	19339	
	BN	32402	63985	52056	53471	49644	25325	9091	5683	6004	7027	12842	16911	
	AN	88051	99722	86990	69589	78076	50019	18214	7932	7862	8162	13980	26763	
	W	113261	114512	103250	92975	96911	68197	27987	11354	8717	11804	30357	77204	
Historical Flow 1956-2003	C / D	14117	17916	17597	9193	7367	4504	3952	3334	4285	6896	9663	12734	87
	BN	27274	48832	32673	14991	10100	4336	3952	5025	7798	12116	15192	18996	
	AN	61801	70133	70404	32283	27876	13444	7172	5985	7865	6766	10940	17093	
	W	94930	111565	87497	67642	46530	29897	14279	10588	15545	13385	23024	60061	
D1641	C	4500 ([1])	7100 - 29200 ([2])					4000	3000	3000	3000	3500		1, 2
	D	4500	7100 - 29200					5000	3500	3000	4000	4500		
	BN	4500	7100 - 29200					6500	4000	3000	4000	4500		
	AN	4500	7100 - 29200					8000	4000	3000	4000	4500		
	W	4500	7100 - 29200					8000	4000	3000	4000	4500		
Draft D1630	All				6700									3
	C					3300	3100	2900						4
	D					4300	3600	3200						
	BN					11400	9500	6500						
	AN					14000	10700	7700						
	W					14000	14000	10000						
	W			10000										5
	BN & AN		12000											6
	All	6600 (if > flow not required by other standards)												7
TBI / NRDC / AR / NHI / EDF	81-100% (driest years)	14000 - 21000			10000 - 17500		3000 - 4200			5750 - 7500				8
	61-80%	21000 - 35000			17500 - 29000		4200 - 5000			7500 - 9000				
	41-60%	35200 - 55000			29000 - 42500		5000 - 8500			9700 - 12400				
	21-40%	55000 - 87500			42500 - 62500		8500 - 25000			12400 - 16100				
	0-20% (wettest years)	87500 - 140000			62500 - 110000		25000 - 50000			16100 - 19000				
CSPA / C-WIN	C	4100	9100		6700				4100					9
	D	9200	23500		10800				9200					
	BN	12100	41000		14400				12100					
	AN	14600	90800		23000				14600					
	W	29000	91800		43000				29000					
EDF / Stillwater (monthly average)	C	11500	26800	26800	17500	17500	7500	4800	4800	4800	6500	5300	7500	10, 11, 12
	D	11500	26800	26800	17500	17500	7500	4800	4800	4800	6500	5300	7500	
	BN	26800	26800	26800	26800	26800	11500	7500	7500	7500	7500	7500	11500	
	AN	26800	26800	26800	26800	26800	11500	11500	11500	11500	11500	11500	17500	
	W	26800	26800	26800	26800	26800	17500	17500	17500	17500	17500	17500	26800	
EDF / Stillwater (peak flows)	C	11500	26800	26800	17500	17500	7500	4800	4800	4800	6500	5300	7500	13
	D	11500	26800	26800	17500	17500	7500	4800	4800	4800	6500	5300	7500	
	BN	26800	90800 ([14])	90800 ([15])	26800	26800	11500	7500	7500	7500	7500	7500	11500	14, 15
	AN	26800	105600 ([16])	105600 ([17])	26800	26800	11500	11500	11500	11500	11500	11500	17500	16, 17
	W	26800	105600 ([18])	105600 ([19])	26800	26800	17500	17500	17500	17500	17500	17500	26800	18, 19
USFWS - OCAP Bio Op	AN									X2 ≤ 81 km (approx. 7000)		X2 ≤ 81 km		20
	W									X2 ≤ 74 km (approx. 12400)		X2 ≤ 74 km		

Appendix A, Table 1. Delta outflow recommendations summary table - con't. (p. 2 of 2)

	Water Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Source / Note
CDFG	All	Recommendation in X2 format: 64 - 75 km (approx. 29200 - 11400 cfs)												21
DWR / SFWC	All	Recommendation to maintain requirements stipulated in D-1641												22
The following is from Fleenor et al. 2010 (Preliminary Draft) - Functional flow approach with exports occurring via a peripheral canal, tunnel, or other alternative form of conveyance.														
Delta Solutions Group	5 of 10 yrs			48000										23

Appendix A, Table 2. Sacramento River inflow recommendations (cfs unless noted otherwise).

	Water Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Source / Note
D1641	C									3000		3500		
	D									3000	4000	4500		
	BN									3000	4000	4500		
	AN									3000	4000	4500		
	W									3000	4000	4500		
Draft D1630	All				≥18000									24
	All				≥13000 (14-day running average) and ≥9000 (min mean daily flow)									25
	C	1500	2500		2000			1000	1000	1500				26
	D	1500	2500		2500			1000	1000	1500				
	BN	2500	2500		3000			2000	1000	2500				
	AN	2500	2500		3000			2000	1000	2500				
	W	2500	3000		5000			3000	1000	5000				
CDFG	All		6000 (base flows)											27
	All				20000 - 30000 (pulse flows @ Rio Vista)									
C-WIN / CSPA	All		6000 (minimum base flows, measured @ Rio Vista)											28
	All				30000 (Freeport to Chipps Island)									29
PCFFA	All				25000 (Hood to Chipps Island)									30
USFWS					The catch of juvenile salmon at Chipps Island between April and June is correlated to flow at Rio Vista. The highest abundance leaving the Delta has been observed when flows at Rio Vista between April and June averaged above 20000 cfs..."									31
AR / NHI	All	Sac Riv at Bend Bridge - Pulse flows continuously exceed 8000, periodically exceed 12000, for a duration exceeding 2 weeks										See Jan - May		32
	All	Sac Riv at Wilkins Slough and Freeport - Pulse flows of 15000 at Wilkins Slough, and up to 20000 at Freeport, should occur for a duration of 7 days or longer. There should be at least 5 such events in dry years and more in wet years											See Jan - May	33
TBI / NRDC / AR / NHI	C (0-20 percentile)			27500 for 15 cont days										34
	D (20-40 percentile)				27500 for 30 cont days									
	BN					30000 for 60 cont days								
	AN					32500 for 90 continous days								
	W					35000 for 120 continuous days								
NMFS	AN & W					≥ 17700 (at Grimes RM125)								35
	AN & W					≥ 31100 (at Verona RM80)								
	All	Provide pulse flows ≥ 20000 cfs, measured at Freeport periodically during winter-run emigration season to facilitate outmigration past Chipps Island (ie, Dec-Apr)											See Jan-Apr	36

Appendix A, Table 2. Sacramento River inflow recommendations - con't. (p. 2 of 2)

	Water Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Source / Note
EDF / Stillwater	C	3500			10000		Determined based on Delta outflows ([38])			3000 - 3500 ([39])			3500	37, 38, 39
	D	4500			10000					3000 - 4500			4500	
	BN	4500			10000					3000 - 4500			4500	
	AN	64000 (pulse flow, 21 consecutive days)												
		4500			10000					3000 - 4500			4500	
	W	64000 (pulse flow, 35 consecutive days)												
		4500			10000					3000 - 4500			4500	
		64000 (pulse flow, 49 consecutive days)												
DWR / SFWC	All	Recommendation to maintain requirements stipulated in D-1641												22
The following is from Fleenor et al. 2010 (Preliminary Draft) - Functional flow approach with exports occurring via a peripheral canal, tunnel, or other alternative form of conveyance.														
Delta Solutions Group	6 of 10 yrs	10000									10000			40
	6 of 10 yrs			25000										
	1 of 10 yrs	70000												41
	8 of 10 yrs		Yolo Bypass 2500 (Sac Riv ~45750)											42
	6 of 10 yrs			Yolo Bypass 4000 (pulse) (Sac Riv ~ 50150)										

Appendix A, Table 3. San Joaquin River inflow recommendations summary table (cfs unless noted otherwise).

	Water Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Source / Note
D1641	C		710 or 1140 ([43])		3110 or 3540 ([44])	710 or 1140 ([43])					1000 ([45])			43, 44, 45
	D		1420 or 2280		4020 or 4880	1420 or 2280					1000			
	BN		1420 or 2280		4620 or 5480	1420 or 2280					1000			
	AN		2130 or 3420		5730 or 7020	2130 or 3420					1000			
	W		2130 or 3420		7330 or 8620	2130 or 3420					1000			
Draft D1630	C				2000 ([46])						≥2000 ([47])			46, 47
	D				4000						≥2000			
	BN				6000						≥2000			
	AN				8000						≥2000			
	W				10000						≥2000			
CDFG	C			1500 (Base)	5500 (Pulse) (4/15-5/15) (Total 7000)									48
	D			2125 (Base)	4875 (Pulse) (4/11-5/20) (Total 7000)									
	BN			2258 (Base)	6242 (Pulse) (4/6-5/25) (Total 8500)									
	AN			4339 (Base)	5661 (Pulse) (4/1-5/30) (Total 10000)									
	W			6315 (Base)	8685 (Pulse) (3/27-6/4) (Total 15000)									
C-WIN / CSPA	C		13400	4500	6700	8900	1200				5400			49
	D		13400 (2 days)	4500	6700	8900	1200				5400			
	BN		13400 (16 days), 26800 (2 days)	4500	6700	8900	11200	1200			5400			
	AN		13400 (13 days), 26800 (5 days)	4500	6700	8900	11200	1200			5400			
	W		13400 (17 days), 26800 (5 days)		13400			14900			5400			
TBI / NRDC	100% of years (all yrs)		2000		5000			2000						50
	80% (D yrs)		2000		5000	10000	7000	5000	2000					
	60% (BN yrs)		2000		20000	10000	7000	5000	2000					
	40% (AN yrs)		2000	5000	20000		7000		2000					
	20% (W yrs)		2000	5000	20000		7000		2000					

Appendix A, Table 3. San Joaquin River inflow recommendations summary table - con't. (p. 2 of 3)

	Water Year	Jan	Feb	Mar		Apr		May		Jun	Jul	Aug	Sept	Oct	Nov	Dec	Source / Note
AR / NHI	100% of years (all yrs)			3000	4000	5000				2000							51
	80% (D yrs)			3000	4000	5000	10000	7000	5000	2000							
	60% (BN yrs)			3000	5000	20000	10000	7000	5000	2000							
	40% (AN yrs)			3000	5000	20000		7000		2000							
	20% (W yrs)			3000	5000	20000		7000		2000							
	All			Flows of approx. 10000 cfs should occur at Vernalis for >5 days. There should be at least 2 such events in dry years, and more in wetter years.													
EDF / Stillwater	All												> 1800 in DWSC				52
	All			Discuss USFWS (1995) and D-1641, no clear recommendation ([55])						Determined based on Delta outflows ([38])				3500 (10-14 days) ([54])	FERC ([53])		38, 53, 54, 55
	C & D	1000 (positive flows at Jersey Pt)														See Jan-Feb	56
	BN & AN	2000 (positive flows at Jersey Pt)														See Jan-Feb	
	W	3000 (positive flows at Jersey Pt)														See Jan-Feb	
	AN	14800 (pulse flow, ≥ 21 consecutive days)															57
	W	14800 (pulse flow, ≥ 35 consecutive days)															
USFWS			"...the Board should consider the Vernalis flows contained in USFWS (2005) [AFRP] and DFG's San Joaquin Escapement Model as a starting point for establishing flow for the protection of salmon and steelhead migrating from the San Joaquin basin"														58
AFRP (salmon doubling)	C		1744	2832		4912		5665									59
	D		1784	3146		5883		7787									
	BN		1809	3481		6721		9912									
	AN		2581	5162		8151		13732									
	W		4433	8866		10487		17369									
AFRP (53% Increase in Salmon Production)	C		1250	1665		2888		3331									60
	D		1350	1850		3459		4579									
	BN		1450	1933		3733		5505									
	AN		1638	2703		4266		7194									
	W		2333	4667		5520		9142									
NMFS OCAP Bio Op						Interim Operations in 2010-2011, min flows at Vernalis ranging from 1500 - 6000 based on New Melones Index												61
		In addition, USBR/DWR shall seek supplemental agreement with SJRGA as soon as possible to achieve the min flows listed below at Vernalis															
	C					1500											
	D					3000											
	BN					4500											
	AN					6000											
	W					6000											

Appendix A, Table 3. San Joaquin River inflow recommendations summary table - con't. (p. 3 of 3)

	Water Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Source / Note
NMFS	AN & W		≥ 14000 (at Vernalis)											62
	AN & W		≥ 7000 (at Newman)											
DWR / SFWC	All	Recommendation to maintain requirements stipulated in D-1641												22
The following is from Fleenor et al. 2010 (Preliminary Draft) - Functional flow approach with exports occurring via a peripheral canal, tunnel, or other alternative form of conveyance.														
Delta Solutions Group	C	2000			5000		2000							63
	D	2000			7000		2000							
	BN	2000			10000		2000							
	AN	2000			15000		2000							
	W	2000			20000		2000							

Appendix A, Table 4. Old and Middle River flow, export restriction, San Joaquin River flows at Jersey Point (e.g., QWEST) recommendations summary table (cfs unless noted otherwise).

	Water Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Source / Note
D1641	All	See Jul-Dec	Export/Inflow Ratio: 35% of Delta Inflow ([64])					Export/Inflow Ratio: 65% of Delta Inflow						64
	All				Export Limit: > of 1500 or 100% of 3-day avg. Vernalis flow									65
Draft D1630	All	QWEST > -2000	No reverse flow for all year types on a 14-day running average in the Western Delta (QWEST > 0 cfs, as calculated in Dayflow)					QWEST > -1000	QWEST > -2000					66
	C & D				14-day running average combined export rate for Tracy, Banks, and Contra Costa pumping plants shall be ≤ 4000 cfs									
	BN, AN, W				14-day running average combined export rate for Tracy, Banks, and Contra Costa pumping plants shall be ≤ 6000 cfs									
CSPA / C-WIN	All			Combined Export Rates = 0										67
	All			2000 cfs daily flow in Old and Middle Rivers										68
	C	1000 (positive 14-day mean flows at SJ Riv at Jersey Pt)									See Jan-June			69
	D	1500 (positive 14-day mean flows at SJ Riv at Jersey Pt)									See Jan-June			
	BN	2000 (positive 14-day mean flows at SJ Riv at Jersey Pt)									See Jan-June			
	AN	2500 (positive 14-day mean flows at SJ Riv at Jersey Pt)									See Jan-June			
	W	3000 (positive 14-day mean flows at SJ Riv at Jersey Pt)									See Jan-June			
TBI / NRDC		Sac Salmonids, Delta Smelt, Longfin Smelt*		Sac & SJR Salmonids, D. Smelt, L. Smelt*	Sac & SJR Salmonids, D. Smelt, L. Smelt (C & D yrs)		Sac & SJR Salmonids, D. Smelt				Sac Basin Salmon		Sac Salmon, D. Smelt	70
	C	-1500 or >0*	-1500 or >0*	-1500 or >0*	>0	>0	-1500				-2000	-2000	-1500	
	D	-1500 or >0*	-1500 or >0*	>0	>0	>0	-1500				-2000	-2000	-1500	
	BN	-1500 or >0*	-1500 or >0*	>0	>0	>0	-1500				-2000	-2000	-1500	
	AN	-1500 or >0*	-1500 or >0*	>0	>0	>0	-1500				-2000	-2000	-1500	
	W	-1500 or >0*	-1500 or >0*	>0	>0	>0	-1500				-2000	-2000	-1500	
AFRP	C / D	1000 (net seaward flows at Jersey Pt)									See Jan-June			71
	BN / AN	2000 (net seaward flows at Jersey Pt)									See Jan-June			
	W	3000 (net seaward flows at Jersey Pt)									See Jan-June			
NMFS - OCAP Bio Op	All	Limit negative flows to -2000 to -5000 cfs in Old and Middle Rivers, depending on the presence of salmonids (see decision tree upon which the negative flow objective w/in the range shall be determined)												72
	All				Export restrictions based on Vernalis flow: <6000 cfs = 1500 cfs export limit 6000-21750 cfs = 4:1 (Vernalis flow:export ratio) >21750 = Unrestricted									

Appendix A, Table 4. Old and Middle River flow, export restriction, San Joaquin River flows at Jersey Point (e.g., QWEST) recommendations summary table - con't. (p. 2 of 2)

	Water Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Source / Note
USFWS	All	Board should develop reverse flow criteria that would maintain Old and Middle River flow positive during key months (Jan - Jun)												73
	All	"...the AFRP Working Paper (USFWS, 1995) Restoration Action #3 calls for maintaining positive QWEST flows, or an equivalent measure of net seaward flows at Jersey Point... Higher flow at Jersey Point has been provided during the VAMP period (mid-April to mid-May) with the adoption of VAMP flows and exports. We encourage the Board to retain or expand this type of action to assure the contribution of downstream flow from the San Joaquin Basin to Delta outflow..."									See Jan - June			74
USFWS - OCAP Bio Op	All	Action 1: -2000 cfs for 14 days once turbidity or salvage trigger has been met. Action 2: range btw -1250 and -5000 cfs ([75])			Range between -1250 and -5000 ([76])								See Jan-Mar	75, 76
CDFG Longfin Smelt Incidental Take Permit	All	Condition 5.1 (Dec - Feb): >-5000 ([77]) Condition 5.2 (Jan - June): OMR flow between -1250 and -5000 cfs ([78])											Condition 5.1 (Dec-Feb)	77, 78
DWR / SFWC	All	Recommendation to maintain requirements stipulated in D-1641												22

Appendix A, Table 5. Floodplain inundation flow recommendations summary table.

	Water Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Source / Note
CDFG	AN & W	≥ 30 day floodplain inundation												79
EDF / Stillwater	BN	64000 (pulse flow, 21 consecutive days)												37
	AN	64000 (pulse flow, 35 consecutive days)												Sacr Riv - Yolo Byp
	W	64000 (pulse flow, 49 consecutive days)												
TBI / NRDC / AR / NHI	C (0-20 percentile)		27500 for 15 cont days											34
	D (20-40 percentile)			27500 for 30 cont days										Sac Riv - Yolo Byp
	BN			30000 for 60 cont days										
	AN		32500 for 90 continous days											
	W	35000 for 120 continuous days												
AR / NHI	All	Sac Riv at Bend Bridge - Pulse flows continuously exceed 8000, periodically exceed 12000, for a duration exceeding 2 weeks										See Jan - May		32
USFWS	6 of 10 yrs	"The Board should consider the importance of more frequent floodplain inundation (especially Yolo Bypass flows) when determining the Delta outflows…"												80
NMFS - OCAP Bio Op	All	"…Reclamation and DWR shall, to the maximum extent of their authorities, provide significantly increased acreage of seasonal floodplain rearing habitat, with biologically appropriate durations and magnitudes, from December through April, in the lower Sacramento River basin, on a return rate of approximately one to three years, depending on water year type."											See Jan-Apr	81
NMFS - Recovery Plan	All	"Enhance the Yolo Bypass by re-configuring Fremont and Sacramento weirs to: … and (6) create annual spring inundation of at least 8000 cfs to fully activate the Yolo Bypass floodplain."												82
Delta Solutions Group	8 of 10 yrs		Yolo Bypass 2500 (Sac Riv ~ 45750)											42
	6 of 10 yrs			Yolo Bypass 4000 (pulse) (Sac Riv ~ 50150)										
San Joaquin River														
EDF / Stillwater	AN	14800 (pulse flow, ≥ 21 consecutive days)												57
	W	14800 (pulse flow, ≥ 35 consecutive days)												
See TBI / NRDC and AR / NHI SJ River Inflow recommendations, flows >20000 cfs to trigger floodplain inundation														

Appendix A, Table 6. Delta Cross Channel closures summary table.

	Water Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Source / Notes
D-1641		see Nov	Gates Closed			Close for 14 days ([83])						Nov-Jan - gates may be closed for up to total of 45 days		83
Draft D-1630	All	Closed if daily DOI >12000	Operated based on results of real-time monitoring											84
CSPA / C-WIN	All		Gates Closed											85
	All		Acoustic Barrier at head of Georgiana Slough at Sacramento River											
NMFS - OCAP Bio Op	All	Dec 15 - Jan 31 Gates closed	Gates Closed per D1641			Gates closed up to 14 days per D1641					Gates closed if fish are present		Gates closed except for experiments/water quality / Dec 15 Jan 31 Gates closed	86

Appendix A, Table 7. Notes for Tables 1 through 6.

No.	Entity	Type	Notes (excerpts from source documents)
1	D1641	Outflow	All water year types - Increase to 6000 if the Dec 8RI is > than 800 TAF
2	D1641	Outflow	Habitat Protection Flows, minimum Delta outflow calculated from a series of rules that are described in Tables 3 and 4 of D1641
3	Draft D1630	Outflow	Striped Bass, Antioch spawning - Delta outflow index, Sac Riv at Chipps Island, average for the period not less than value shown (cfs).
4	Draft D1630	Outflow	Striped Bass, general - Delta outflow index, Sac River at Chipps Island - average for period not less than value shown (cfs), May period = May 6-31
5	Draft D1630	Outflow	Suisun Marsh - Delta outflow index at Sac River at Chipps Island - average of daily DOI for each month, not less than value shown (cfs)
6	Draft D1630	Outflow	Suisun Marsh - Delta outlflow index, Sac River at Chipps Island - minimum daily DOI for 60 consecutive days in the period
7	Draft D1630	Outflow	Suisun Marsh - Delta outflow index, Sac River at Chipps Island - average of daily DOI for each month, not less than value shown, in cfs: applies whenever storage is at or above minimum level in flood control reservation envelope at two of the following - Shasta Reservoir, Oroville Reservoir, and CVP storage on the American River
8	TBI et al	Outflow	Water year categories represent exceedance frequencies for the 8-river index, they are not equivalent to the DWR "water year types" (which account for storage and other conditions). TBI_Exhibit 2 (Outlfow). References for correlation btw winter-spring outlfow and abundance of numerous species on p.3. Winter-spring Delta outflow criteria approximate the frequence distribution of outflow levels, i.e., the relationship btw outflow and the 8 River Index, for the 1956-1987 period. Winter and spring outlfow recommendations to benefit public trust uses of pelagic species (as represented by abundance and productivity of longfin smelt, Crangon shrimp, and starry flounder and spatial distribution of longfin smelt) (see TBI Exhibit 2, pp 21-25). Two methods were used to develop outflow criteria: an analysis of historical flow-abundance relationships that corresponded to recovery targets for longfin smelt abundance (Native Fishes Recovery Plan, USFWS 1995), and an analysis of population growth response to outflows in order to identify outflows that produced population growth more than 50% of the time. Applying these
8 cont	TBI et al	Outflow	two methods produces very similar results regarding desirable outflow levels. Break in summary table at mid-Mar is artificial, original table included Mar under both Winter and Spring, so for simplicity, it was split at 15 Mar. Fall outflows (TBI Exhibit 2, p. 35, Table 1 and Fig 27) - analyzed emerging statistical evidence of relationship btw outlfow and abundance and distribution of delta smelt and striped bass (Feyrer et al 2007; Feyrer et al In Review; DSWG notes, Aug 21, 2006), in order to develop recommendations. Recommendations occassionaly exceed unimpaired outflow in limited cases (would require reservoir releases in fall independent of antecedent conditions).

Appendix A, Table 7. Notes for Tables 1 through 6.

No.	Entity	Type	Notes (excerpts from source documents)
9	CSPA / C-WIN	Outflow	Net Delta Outflow, as a 14-day running average - Source WRINT-DFG Exh 8 (1992). Feb-Mar - flows correspond to Table 8 (p.23), Alternative C (Estuarine species - target mean monthly flows based on data from DWR's 1995 Level of Development + 50% increase). Orig. recommendations by month, C-WIN/CSPA took average of Feb and Mar, and reported as such. Apr-July - flows correspond to Table 2 (p16), Alternative C (mean Delta outflows required to maintain populations of 1.7 million adult striped bass). Aug-Jan - based on Alt C (discussed above), in combination with flow recommendations developed by C-WIN for Jan. DFG identified flows for all months except Jan, C-WIN developed a method for Jan flows from DayFlow information (C-WIN extracted monthly average Delta outflows from DayFlow, sorted them, and then allocated them to water years based on unimpaired runoff data from the California Data Exchange Center. The medians of the water year types were then used as January flows in developing our optimal conditions recommendations for mean Delta outflows in the August 1 through January 31 period).
10	EDF / Stillwater	Outflow	Stillwater Focal Species Approach - Source - EDF closing comments (Table 1), Supporting Info - EDF Exhibit 1 (Winter [Dec-Feb] outflows - p.52-53). A primary objective was to provide enough Delta outflow to maintain X2 westward of 65 km, w/ variations to allow eastward excursion of X2 as far as 80 km in drier water year types. Proximate function is to increasethe westward extent of fresh water into Suisun and San Francisco bays to more closely approximate historical conditions. "This will serve to increase the availability of food resources to larval fish species in late winter as well as improve access to low salinity habitat in the shallows of Grizzly and Honker bays (Feyrer et al 2009)." Flows also designed to limit the eastward distribution and density of overbite clam. "...low salinity may inhibit spawning and subsequent adult recruitment, thereby reducing grazing pressures on phytoplankton and the pelagic food web. Improvements in food resources to the western Delta will serve to increase populations of Delta smelt, striped bass, and other pelagic species that are currently in decline."
11	EDF / Stillwater	Outflow	Stillwater Focal Species Approach - Source - EDF closing comments (Table 1), Supporting Info - EDF Exhibit 1 (Spring [Mar-May] Outlfows - p.55-56). Spring flows primarily based on delta outflows needed to maintain X2 in locations that are beneficial to delta pelagic fish populations as well as the provision of floodplain inundation in the Yolo Bypass during March Primary objective was to provide enough Delta outflow to maintain X2 westward of 65 km, w/ variations to allow eastward excursion of X2 as far as 70 km in drier water year types. References in justification: Feyrer et al. In Revision, Bennett et al 2005. Herbold 1994, Hobbs et al 2004, Bennett et al. 2008, and others). Secondary goal is to provide sufficient flows to maintain inundated season floodplain habitat in Yolo Bypass and lower SJ Riv for varying periods in March based on water year type. These floodplain inundation flows should be coordinated with flows in late winter to provide prolonged periods of inundation.
12	EDF / Stillwater	Outflow	Stillwater Focal Species Approach - Source - EDF closing comments (Table 1), Supporting Info - EDF Exhibit 1 (Fall [Sept-Nov] - pp.49-50; Summer - pp.57-58) Summer (Jun-Aug) and Fall flows based primarily on Delta outflows needed to maintain X2 in the shallow-water habitats of Suisun Bay. Secondary objective for Fall outflows from the Delta were to provide attraction flows for upstream-migrating salmonids and to maintain adequate DO concentrations for fall-run chinook salmon within the lower SJ River system. Summer and Fall - in some months and water year types, depending on water year type and month, the projected monthly outflows are higher than the unimpaired and/or current flow ranges. Thus some modification of upstream reservoir release schedules may be required to meet these flows. Fall - references in justification - Feyrer et al 2007; Feyrer et al In revision; Bennet et al 2002; Jassby et al 1995; and others

Appendix A, Table 7. Notes for Tables 1 through 6.

No.	Entity	Type	Notes (excerpts from source documents)
13	EDF / Stillwater	Outflow	EDF_Closing Comments (Table 1) - Peak flows required to provide floodplain inundation are assumed to be concurrent between the Sac and SJ River basins as well as the east side tributaries. However, the duration of the peak flows varies by water year (see notes 69-74)
14	EDF / Stillwater	Outflow	EDF_Closing Comments (Table 1) - Includes 14 days of floodplain inundation flow of 64000 cfs in the Sac River
15	EDF / Stillwater	Outflow	EDF_Closing Comments (Table 1) - Includes 7 days of floodplain inundation flow of 64000 cfs in the Sac River
16	EDF / Stillwater	Outflow	EDF_Closing Comments (Table 1) - Includes 21 days of floodplain inundation flow of 64000 cfs in the Sac River and 14 days of floodplain inundation flow of 14800 cfs in the SJ River
17	EDF / Stillwater	Outflow	EDF_Closing Comments (Table 1) - Includes 14 days of floodplain inundation flow of 64000 cfs in the Sac River and 7 days of floodplain inundation flow of 14800 cfs in the SJ River.
18	EDF / Stillwater	Outflow	EDF_Closing Comments (Table 1) - Includes 28 days of floodplain inundation flow of 64000 cfs in the Sac River and 21 days of floodplain inundation flow if 14800 cfs in the SJ River
19	EDF / Stillwater	Outflow	EDF_Closing Comments (Table 1) - Includes 21 days of floodplain inundation flow of 64000 cfs in the Sac River and 14 days of floodplain inundation flow of 14800 cfs in the SJ River
20	USFWS	Outflow	Delta smelt biological opinion (RPA concerning Fall X2 requirements [pp. 282-283] - improve fall habitat [quality and quantity] for DS) (references USFWS 2008, Feyrer et al 2007, Feyrer et al in revision) - Sept-Oct in years when the preceeding precipitation and runoff period was wet or above normal, as defined by the Sacramento Basin 40-30-30 Index, USBR and DWR shall provide sufficient Delta outflow to maintain monthly average X2 no greater than 74 km and 81 km in Wet and Above Normal yrs, respectively. During any November when the preceding water yr was W or AN, as defined by Sac Basin 40-30-30 index, all inflow into the CVP/SWP reservoirs in the Sac Basin shall be added to reservoir releases in Nov to provide additional increment of outflow from Delta to augment Delta outflow up to the fall X2 of 74 km and 81 km for W and AN water yrs, respectively. In the event there is an increase in storage during any Nov this action applies, the increase in reservoir storage shall be released in December to augment the Dec outflow requirements in SWRCB D-1641.
21	CDFG	Outflow	Outflow recommendations from closing comments. Originally provided as X2 recommendations - Source - DFG Exhibit 1 and Exhibit 2 - Consolidates recommendations for American Shad, Longfin Smelt, Starry Flounder, Bay Shrimp, Zooplankton (consistent with D1641 requirements to maintain X2 at one of two compliance points in Suisun Bay [64 km or 75 km] from Feb-June). Longfin smelt = Jan - June; Starry flounder, Bay shrimp, zooplankton = Feb - Jun; and American Shad = April - June.
22	DWR / SFWC	Outflow, SJ Riv Inflow, Sac Riv Inflow, OMR	DWR_closing comments, in response to request for a table identifing recommended flows, DWR submitted summary of D-1641 objectives.

Appendix A, Table 7. Notes for Tables 1 through 6.

No.	Entity	Type	Notes (excerpts from source documents)
23	UCDavis - Delta Solutions Group	Outflow	Functional Flow 5a - Delta Smelt flows, 48000 cfs, from March through May (5 out of 10 years, every other year). Maintain freshwater to low salinity habitat in the northeastern Delta to Napa River, facilitating a broad spatial and temporal range in spawning and rearing habitat (Bennett 2005, Hobbs et al 2005). Flow recommendation not based on water year type, but rather number of years out of 10. Based on exports through an alternative form of conveyance (e.g., peripheral canal or tunnel).
24	Draft D1630	Sac River Inflow	Function = Chinook salmon. Sac River at Freeport. Average flow at Freeport >18000 cfs for a 14-day continuous period corresponding to release of salmon smolts from Coleman Nat Fish Hatchery. Anticipate to occur in late April or early May. If no fish are released from the hatchery, the Executive Director shall determine the appropriate timing of this pulse flow with advice from CDFG.
25	Draft D1630	Sac River Inflow	Function = striped bass, general; Sac River at Freeport - 14-day running average at Freeport >13000 cfs for a 42-day continuous period, with minimum mean daily flow >9000 cfs. Requirement initiated when real-time monitoring indicates the presence of striped bass eggs and larvae in Sac River below Colusa. This period should begin in late April or early May in most years.
26	Draft D1630	Sac River Inflow	Function = chinook salmon. Sac River at Rio Vista - 14-day running average of minimum daily flow.
27	CDFG	Sac River Inflow	Chinook salmon, smolt outmigration. (1) Feb - Oct base flows. Source - DFG Exhibit 14 (WRINT-DFG-8, p.11). (2) Apr - Jun pulse flows. Source - DFG Exhibit 1, page 1, 6, and USFWS Exhibit 31 (Kjelson).
28	CSPA	Sac River Inflow	CSPA Closing Comments. Source - CDFG_1992_WRINT-DFG-Exhibit #8, p.11. Minimum base flow, measured at Rio Vista. 14-day average flow.
29	CSPA / C-WIN	Sac River Inflow	Sacramento River from Freeport to Chipps Island - Pulse flows - flows needed to sustain viable migration corridor for optimal smolt passage and survival. Source - USFWS Exhibit 31 (Kjelson)
30	PCFFA	Sac River Inflow	Function = salmonid juvenile outmigration. PCFFA closing comments, Source - USFWS Exhibit 31 (Kjelson). Kjelson and Brandes research - found that flows of 20000 to 30000 cfs yield the greatest survival of juvenile salmon during out-migration from Sac River to San Francisco Bay (PCFFA recommends splitting the difference and setting standard at 25000 cfs). Set from Hood to Chipps Island.
31	USFWS	Sac River Inflow	USFWS testimony concerning scientific information used to determine flow criteria. Source: U.S. Department Of the Interior - Comments Regarding the California State Water Resources Control Board's Notice of Public Informational Proceeding to Develop Delta Flow Criteria for the Delta Ecosystem Necessary to Protect Public Trust Resources, Sections II and III, pages 25, 54, and 57. "The catch of juvenile salmon at Chipps Island between April and June is correlated to flow at Rio Vista (USFWS, 1987; Brandes and McLain, 2001; Brandes et al., 2006). The highest abundance leaving the Delta has been observed when flows at Rio Vista between April and June averaged above 20,000 cfs which is also the level where we have observed maximum survival in the past (USFWS, 1987)" (p.25).

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No.	Entity	Type	Notes (excerpts from source documents)
32	AR / NHI	Sac River Inflow	AR_NHI_Exh1 (testimony of Cain, Opperman, and Tompkins) and AR_NHI_closing comments. Purpose - interconnect side channels with main channel, contribute to foodweb productivity and rearing habitat for salmon. Inundated off-channel habitat such as high flow channels can also provide rearing habitat for salmon (Peterson and Reid 1984), but regulated spring flows are generally insufficient to inundate these habitats for prolonged periods (30-60 days), A recent study of these habitats in the Sac River determined that a large proportion of secondary channels between Red Bluff and Colusa become fully connected to the river at flows above 12000 cfs (Kondolf 2007). (from AR_NHI_Exh1 p.28)
33	AR / NHI	Sac River Inflow	AR_NHI_Exh1 (Testimony of Cain, Opperman, and Tompkins) and AR_NHI_closing comments - aid migration of winter-run chinook, in later months aid migration of spring and fall-run. Recent analyses indicate that the onset of emigration of winter-run fish to the Delta at Knights Landing is triggered by flow pulses of 15000 cfs at Wilkins Slough, and emigration from the Sac River to Chipps Island follows pulse flows of 20000 cfs at Freeport (del Rosario 2009). Previous studies found that smolt survival increased with increasing Sac River flow at Rio Vista, with maximum survival observed at or above about 20000 and 30000 cfs (USFWS 1987, Exhibit 31). Despite uncertainty about the exact magnitude of flow necessary to initiate substantial bank erosion, there is growing evidence that flows between 20000 and 25000 cfs will erode some banks while flows above 50000 to 60000 cfs are likely to cause widespread bank erosion (Stillwater 2007).
34	TBI / NRDC / AR / NHI	Sac River Inflow	TBI_Exh3 (Inflows - Table 3), TBI_closing comments (Table 3), AR/NHI_Exh1 (Testimony of Cain, Opperman, and Tompkins), AR/NHI closing comments - Table 3. Flows recommended for floodplain inundation (Sutter and Yolo Bypasses) - salmonid rearing, splittail spawning and early rearing. Flows measured at Verona. Flow magnitudes assume structural modifications to the weir to allow inundation at lower flow rates than is currently possible. Reservoir releases should be timed to coincide with and extend duration of high flows that occur naturally on less regulated rivers and creeks. The duration target is fixed for each year type, but actual timing of inundation should vary across the optimal window depending on hydrology and to maintain life history diversity.
35	NMFS	Sac River Inflow	NMFS_Exh9 (from ARFP 1995), Sturgeon (Grn and Wht) - adult migration to spawning and downstream larval transport
36	NMFS	Sac River Inflow	Public Draft Recovery Plan for Central Valley Salmon and Steelhead (October 2009). NMFS_Exhibit_5. Section 6.1.1 Recovery Action Narrative, Action 1.5.9, p.158.
37	EDF / Stillwater	Sac River Inflow	Source: EDF_Exh1 (Stillwater Sciences - Focal Species Approach). Spring flows - Establishing base flows of at least 10000 cfs in the Sac Riv in spring would improve transport of eggs and larval striped bass and other young anadromous fish and to reduce egg settling and mortality at low flows (USFWS 2001, EDF_Exh1, p.53). Proximate function of Delta inflows is to maintain net transport of passively swimming fishes (juv salmonids, larval delta smelt, and striped bass) and nutrients towards Suisun and San Francisco bays (USFWS 2008). Goal of winter and spring floodplain activation flows (managed pulse flows of approx 64000 cfs at Verona) is to maintain inundated seasonal floodplain habitat conditions in much of Yolo Bypass during January and April for a minimum of 21, 35, and 49 days in Below Normal, Above Normal, and Wet water year types, respectively. The NMFS (2009) draft recovery plan for Sac winter-run chinook, CV spring-run chinook, and CV steelhead ESUs calls for an annual spring flow of 8000 cfs (approx 64000 cfs at Verona) above the initial spill level "to fully activate the Yolo Bypass floodplain." For the

Appendix A, Table 7. Notes for Tables 1 through 6.

No.	Entity	Type	Notes (excerpts from source documents)
37 cont	EDF / Stillwater	Sac River Inflow	purposes of this assessment, Stillwater allocated the Delta inflows for floodplain inundation to February and March. Summer Delta inflows to be determined by Delta outflows. Fall Inflows - Maintenance of D1641 flow standards in necessary to provide attraction flows for Chinook salmon, although these levels would potentially need to be increased to provide adequate Delta outflows. Winter Inflows - Winter flows primarily designed to provide upstream migration passage for salmonids and striped bass during Dec and Jan, as well as to inundate floodplains such as Yolo Bypass for benefit of rearing juv salmonids and other floodplain associated species (p.50-51). See Spring for discussion of goal of combined winter-spring floodplain activation flows.
38	EDF / Stillwater	Sac Riv Inflow / SJ Riv Inflow	Inflows determined based on Delta outflows (EDF_Exh1 - Stillwater Focal Species)
39	EDF / Stillwater	Sac River Inflow	These levels may need to be increased to provide adequate Delta outflows (EDF_Exh1 - Stillwater Focal Species)
40	UCDavis - Delta Solutions Group	Sac River Inflow	Functional Flow 2a - Sac River adult salmon - 10000 cfs to to occur from Oct - June during 6 out of 10 years (references Newman and Rice 2002, Williams 2006, Harrell et al. 2009, USFWS Exhibit 31 1987, Kjelson and Brandes 1989). Functional Flow 2b - Sac River juvenile salmon migration - 25000 cfs from Mar - June during 6 out of 10 years (references Newman and Rice 2002, Williams 2006, Harrell et al. 2009, USFWS Exhibit 31 1987, Kjelson and Brandes 1989). Flows not based on water year type, but rather number of years out of ten.
41	UCDavis - Delta Solutions Group	Sac River Inflow	Functional Flow 2c - Sacr River adult sturgeon flows - 70000 cfs to occur between Jan and May during 1 out of 10 years (flows for salmon -2a, 2b, and 1a,1b) (Kohlhorst et al 1991 [flow rate], Harrell and Sommer 2003 [passage problems at Fremont Weir]). Flows not based on water year type, but rather number of years out of ten.
42	UCDavis - Delta Solutions Group	Sac River Inflow	Functional Flow 1a - yolo bypass inundation - salmon and splittail (area inundated based on recommended flows BDCP draft rpt 2008) (other references related to flow and corresponding extent of habitat in Yolo Bypass Moyle et al. 2004, Sommer et al. 2004, Harrell and Sommer 2003, Harrell et al. 2009). Functional Flow 1b - yolo bypass pulse - salmon and splittail (area inundated based on recommended flows BDCP draft rpt 2008) (other references related to flow and corresponding extent of habitat in Yolo Bypass Moyle et al. 2004, Sommer et al. 2004, Harrell and Sommer 2003, Harrell et al. 2009). Functional Flows 1a and 1b require flows at Freeport of approx. 45750 and 50150 cfs, respectively, based on regressions of historical data.
43	D1641	SJ River Inflow	Base Vernalis minimum monthly average flow rate in cfs (the 7-day running average shall not be less than 20% below the objective). Take the higher objective if X2 is required to be west of Chipps Island
44	D1641	SJ River Inflow	Pulse Vernalis minimum monthly average flow rate in cfs. Take the higher objective if X2 is required to be west of Chipps Island
45	D1641	SJ River Inflow	Pulse - up to an additional 28 TAF pulse/attraction flow to bring flows up to a monthly average of 2000 cfs except for a critical year following a critical year. Time period based on real-time monitoring and determined by CalFed Op's group

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No.	Entity	Type	Notes (excerpts from source documents)
46	Draft D1630	SJ River Inflow	SJ River at Vernalis. Function = chinook salmon. Minimum daily flow, in cfs, for 21-day continuous period. Start date depends on beginning of chinook salmon smolt out-migration from SJ basin. During this time, water right holders on Mokelumne and Calaveras rivers shall bypass all inflows for 5 consecutive days. Daily mean combined pumping at Tracy, Banks, and Contra Costa pumping plants shall be ≤1500 cfs. All pumping restrictions are to be split equally between CVP and SWP. Total annual maximum of 150 TAF for the two salmon flows (these and fall attraction flows) from the SJ Basin reservoirs
47	Draft D1630	SJ River Inflow	SJ River at Vernalis. Function = chinook salmon. Minimum daily flow, for 14-day continuous period. Start date depends upon beginning of chinook salmon adult spawning migration. Attraction flow shall be provided only if water is avaiable from the 150 TAF alloted for the two salmon flows. During this time, water right holders on Mokelumne and Calaveras rivers shall bypass all inflows for 5 consecutive days.
48	CDFG	SJ River Inflow	Source: SJR Salmon Model V.1.6 (CDFG 2009), DFG Exhibit 3 (Flows needed in the Delta to restore anadromous salmonid passage from the SJ River at Vernalis to Chipps Island) - Table 10 - South Delta (Vernalis) flows needed to double smolt production at Chipps Island (by water year type), and CDFG closing comments. Flows to support smolt outmigration.
49	CSPA / C-WIN	SJ River Inflow	CSPA and C-WIN Closing Comments - CSPA Table 2. Based on WRINT-DFG Exhibit 8 (1992) and C. Mesick 2010 (C-Win Exh 19). Pulse flows in all years to attract adult spawning salmonids, Oct 20-29, SJR at Vernalis. To the tributary flows (each measured at their confluence with SJ Riv mainstem (see Mesick 2010), C-WIN / CSPA added in a flow of the SJ Riv below Millerton Lake reflecting that river's fair share unimpaired flow, as well as accretions and other inflows. Combined valley flows at Vernalis assumes tributaries (Mer, Stan, Tuol) are 67.06% of total SJ River flow at Vernalis. Spring - pulse flows for temperature regulation, migration cues, habitat inundation. Oct - pulse flows to attract adult salmonids.
50	TBI / NRDC	SJ River Inflow	TBI Exhibit 3 - Delta Inflows (Table 1, p.28), TBI / NRDC closing comments (Table 3b). Flows >5000 cfs to maintain minimum temperature (≤ 65F) for migrating salmonids in April and May. Flows >20000 to trigger floodplain inundation. Year-round flows should exceed 2000 cfs to alleviate potential for DO problems in DWSC.
51	AR / NHI	SJ River Inflow	AR_NHI_Exh1 (testimony of Cain, Opperman, and Tompkins) and AR_NHI_closing comments (Table 2). SJ River flows to benefit salmon rearing habitat and smolt out-migration (increase flow velocities and turbidity), with focus on temperature (maintain temp at or below 65F) and floodplain inundation. Criteria recommended to be in addition to those stipulated in D1641.
52	EDF / Stillwater	SJ River Inflow	EDF / Stillwater Exh 1 (focal species approach, pp.47-49). Based upon investigations for the SJ River DO TMDL, minimum instream flows at the Stockton DWSC should be maintained in excess of 1,800 cfs during Sept and Oct of each year. Low DO in the lower SJ River has been found to impede upstream salmon migration (NMFS 2009, p.74). Studies by Hallock (1970) indicate that low DO at Stockton delay upmigration and straying rates.
53	EDF / Stillwater	SJ River Inflow	EDF / Stillwater Exh 1 (focal species approach, pp.47-49). Flows during November should correspond to current minimum Federal Energy Regulatory Commission (FERC) spawning flow requirements from the Stanislaus, Tuolumne, Merced, and upper San Joaquin rivers.

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No.	Entity	Type	Notes (excerpts from source documents)
54	EDF / Stillwater	SJ River Inflow	EDF / Stillwater Exh 1 (focal species approach, pp.47-49). Salmonid spawning attraction flows in excess if 3500 cfs at Vernalis should be provided for 10-14 days during October, using coordinated releases from the SJ River and tributaries. For remainder of fall, Delta inflows would be determined by the minimum instream flow requirements of the SJ River basin and east side tributaries. Upstream flow levels would likely be increased to meet the Delta outflow recommendations.
55	EDF / Stillwater	SJ River Inflow	EDF / Stillwater Exh 1 (focal species approach, pp.54). "Although USFWS (1995) previously recommended spring Delta inflows ranging from 4,050 cfs to 15,750 cfs at Vernalis based upon of regression models of Chinook salmon smolt survival. The current D-1641 flow minimums range from 3,110 cfs to 8,620 cfs (Table 1-5), depending upon water year type, have never been fully implemented. In addition to baseline flows, for the benefit of rearing Chinook salmon and other native fishes, floodplain activation flows should be provided..."
56	EDF / Stillwater	SJ River Inflow	EDF / Stillwater Exh 1 (focal species approach, pp.51-52). Winter Inflows - Minimum flows at Vernalis and the eastside tributaries should be coordinated to maintain net seaward flows at Jersey Point of 1000 cfs in Critical and Dry years, 2000 cfs in Below and Above Normal years, and 3000 cfs in Wet years (USFWS 1995 3-Xe-19). Net seaward flows for benefit of outmigrating juvenile salmon.
57	EDF / Stillwater	SJ River Inflow	EDF / Stillwater Exh 1 (focal species approach, pp.54-55). For the benefit of rearing chinook salmon and other native fishes, floodplain activation flows should be provided of 14800 cfs in the lower SJ River in Above Normal and Wet water year types. A series of pulse flows instead of a single extended high flow event might also be used to achieve the desired target of continuous days of inundated floodplain. Goal for combined winter and spring floodplain activation flows is to maintain inundated seasonal floodplain habitat conditions (or the potential for such conditions in sites where floodplain restoration actions may be undertaken in the future) in the lower SJ River during Jan through Apr for a minimum of 21 and 35 consecutive days in Above Normal and Wet water year types, respectively. For the purposes of this assessment, Stillwater allocated the Delta inflows for floodplain inundation to February and March. Also discusses inundation of Cosumnes River floodplain.
58	USFWS	SJ River Inflow	USFWS testimony concerning scientific information used to determine flow criteria. Source: U.S. Department Of the Interior - Comments Regarding the California State Water Resources Control Board's Notice of Public Informational Proceeding to Develop Delta Flow Criteria for the Delta Ecosystem Necessary to Protect Public Trust Resources, Sections II and III, pages 56-57 and 25. Quote in table from p.56-57. "The Anadromous Fish Restoration Program has developed estimates of flow levels needed at Vernalis to achieve a 53% increase (page 9) and a doubling (page 10) in predicted Chinook salmon production for the basin (USFWS, 2005). These Vernalis flow criteria vary by water year type and by month between February and May. We recommend these flows as starting point for establishing minimum and maximum volume of flow for increasing juvenile salmon and steelhead survival in the San Joaquin basin." (p.25).
59	AFRP	SJ River Inflow	Anadromous Fish Restoration Program (ARFP). Recommended streamflow schedules to meet the AFRP Doubling Goal in the San Joaquin River Basin (USFWS, 27 Sept 2005). Salmon doubling - total average flow (Stanislaus, Tuolumne, Merced) that would be expected to double the total predicted Chinook salmon production for the basin.

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No.	Entity	Type	Notes (excerpts from source documents)
60	AFRP	SJ River Inflow	Anadromous Fish Restoration Program (ARFP) - Recommended streamflow schedules to meet the AFRP Doubling Goal in the San Joaquin River Basin (USFWS, 27 Sept 2005). Total average flow (Stanislaus, Tuolumne, Merced) that would be expected to achieve a 53% increase in total predicted Chinook salmon production for the basin.
61	NMFS	SJ River Inflow	NMFS OCAP Bio Opinion, Action IV.2.1 (pp.641-644) San Joaquin River Inflow to Export Ratio - both interim (2010-2011) and long-term (beginning in 2012) requirements are stipulated. Interim flows are based on maintaining a minimum status quo for SJ River basin salmonid populations. Long term flow schedules for the SJ River are expected to result from SWRCB proceedings on SJ River flows. Export limitations and flows are also described on pp. 642-644
62	NMFS	SJ River Inflow	NMFS_Exh9 (from AFRP 1995) - Sturgeon (Green and White), mean monthly flows - ensure suitable conditions for sturgeon to migrate and spawn and for progeny to survive.
63	UCDavis - Delta Solutions Group	SJ River Inflow	Functional Flows 3a - transport juvenile salmon (references USFWS Exhibit 31, 1987; Newman and Rice 2002; Williams 2006) - wet years - 20000 cfs, Apr-Jun (2 out of 10 years); AN years - 15000 cfs, April - Jun 15 (4 out of 10 years); BN years - 10000 cfs, Apr-May (6 out of 10 years); Dry years - 7000 cfs, Apr-May 15 (8 out of 10 years); and Critical years - 5000 cfs, Apr (10 out of 10 years). Functional Flows 3c - adult salmon recruitment (reference USFWS Exhibit 31, 1987) - 2000 cfs year round (10 out of 10 years) (flows were not experienced in unimpaired conditions, but likely result from the disturbed conditions). Functional Flows 3b - Improve DO conditions in DWSC (2000 cfs, July-Oct, all years) (Lehman et al 2004, Jassby and VanNieuwenhuyse 2005).
64	D1641	OMR	Export/Inflow ratio - the maximum percent Delta inflow diverted for Feb may vary depending on the Jan 8RI (see D1641)
65	D1641	OMR	SWP/CVP Export Limit - All water year types, Apr 15 - May 15, the greater of 1500 cfs or 100% of 3-day avg. Vernalis flow. Maximum 3-day average of combined export rate (cfs), which includes Tracy Pumping Plant and Clifton Court Forebay Inflow less Byron-Bethany pumping. The time period may need to be adjusted to coincide with fish migration. Maximum export rate may be varied by CalFed Ops Group.
66	Draft D1630	OMR	Reverse flow restrictions for all year types are relaxed when combined CVP and SWP exports are < 2000 cfs. Export pumping restriction is relaxed for all year types when Delta outflow > 50000 cfs, except for the export pumping restriction during the SJ River pulse period. July 1 - Jan 31 - 14-day running average flow (as calculated in DAYFLOW), these restrictions do not apply whenever the EC at the Mallard Slough monitoring station is < 3 mmhos/cm. QWEST standards in 1630 discussed in DOI submittal, p.53, section concerning reverse flows.
67	CSPA / C-WIN	OMR	CSPA closing comments, C-WIN closing comments, CSPA_Exh1_Jennings. Combined export rates would be 0 cfs in all years from March 16 through June 30. Prevent entrainment and keep migration corridors open to maximize salmon juvenile and smolt survival. Facilitate SJ River salmonid migration down Old River.
68	CSPA / C-WIN	OMR	CSPA and C-WIN closing comments - flow direction, entrainment protection and provision of migration corridors

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No.	Entity	Type	Notes (excerpts from source documents)
69	CSPA / C-WIN	OMR	SJ River at Jersey Point flow recommendations (positive 14-day mean flows). Source: CSPA_exh1_Jennings_test; CDFG_1992_WRINT-DFG-Exhibit #8, Alt C (p.11, flows at Jersey Pt from Apr 1 through June 30, salmon); AFRP Working Paper, 1995, p. 3-Xe-19 (salmon). Function maintain positive flow for salmonid smolt outmigration and protect Delta smelt, originally two separate recommendations. DS - Feb 1 - Jun 30, Salmon - Oct 1 - Jun 30, only difference between flow recommendations where overlap occurred was DS in AN years = 2500 cfs, salmon in AN years = 2000. For this table, recommendations merged and 2500 cfs used for AN years (+DFG Exh 8 recommends 2500 cfs in AN years)
70	TBI / NRDC	OMR	TBI/NRDC closing comments (Table 4). The hydrodynamic recommendations expressed as Vernalis flow and/or export to inflow ratios in TBI/NRDC Exh4 (Delta Hydrodynamics, p.30) were converted to OMR flows, using the San Joaquin flow recommendations as described in TBI/NRDC Exh 3 (Delta Inflows), for inclusion in Table 4. Note: recommended OMR flows assume SJ River flows recommended in TBI Exhibit 3 are also implemented. (*) - when the previous longin smelt FMWT index <500, OMR flows in Jan-Mar are >0. This corrects a typographical error in the table on p.30 of TBI Exhibit 4
71	AFRP	OMR	Anadromous Fish Restoration Program (ARFP) (Working Paper on Restoration Needs, Habitat Restoration Actions to Double Natural Production of Anadromous Fish in the Central Valley of California, Volume 3, 1995, p. 3-Xe-19). Action 3 - Maintain positive QWEST flows, or an equivalent measure of net seaward flows at Jersey Point, of 1000 cfs in Critical and Dry years, 2000 cfs in below- and above normal years, and 3000 cfs in wet years from Oct 1 through June 30. Objective - Increase survival of smolts migrating down the mainstem rivers, decrease the number of smolts diverted into the central Delta, increase the survival of smolts diverted into the central Delta, and provide attraction flows for San Joaquin Basin adults (Oct - Dec).
72	NMFS	OMR	NMFS OCAP Bio Opinion, Action IV.2.3 - Old and Middle River Flow Management (pp. 648-652). See action triggers on pp. 648-650. Actions will be taken in coordination with USFWS RPA for Delta Smelt and State-listed longfin smelt 2081 incidental take permit. During the Jan 1 - Jun 15 period, the most restrictive export reduction shall be implemented.
73	USFWS	OMR	USFWS testimony concerning scientific information used to determine flow criteria. Source: U.S. Department Of the Interior - Comments Regarding the California State Water Resources Control Board's Notice of Public Informational Proceeding to Develop Delta Flow Criteria for the Delta Ecosystem Necessary to Protect Public Trust Resources, Sections II and III, pages 50, 53, and 24-25 (references USFWS 1992; AFRP Working Paper p.3-Xe-19, USFWS 2005, Restoration Action #3; D-1630, pp44-47). "Based on the scientific information we reviewed, the Board should develop reverse flow criteria that would maintain the Old and Middle river flow positive during key months (January through June) of the year to protect important public trust resources in the Delta" (p.53).

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No.	Entity	Type	Notes (excerpts from source documents)
74	USFWS	OMR	USFWS testimony concerning scientific information used to determine flow criteria. Source: U.S. Department Of the Interior - Comments Regarding the California State Water Resources Control Board's Notice of Public Informational Proceeding to Develop Delta Flow Criteria for the Delta Ecosystem Necessary to Protect Public Trust Resources, Sections II and III, pages 24,25, and 53. "In a previous Board exhibit (USFWS, 1992), we showed a positive relationship between temperature corrected juvenile survival indices and flow at Jersey Point for marked fish released at Jersey Point (QWEST) (USFWS, 1992, p.21). In addition, the AFRP Working Paper (USFWS, 1995) Restoration Action #3 calls for maintaining positive QWEST flows, or an equivalent measure of net seaward flows at Jersey Point, of 1000 cfs in critical and dry years, 2000 cfs in below- and above-normal years, and 3000 cfs in wet years from Oct 1 through June 30. Higher flow at Jersey Point has been provided during the VAMP period (mid-April to mid-May) with the adoption of VAMP flows and exports. We encourage the Board to retain or expand this
74 cont	USFWS	OMR	type of action to assure the contribution of downstream flow from the San Joaquin Basin to Delta outflow for the protection of juvenile and adult salmonids migrating from the San Joaquin basin."
75	USFWS	OMR	USFWS OCAP Bio Opinion - RPA re: OMR flows. Component 1 - Adults (Dec - Mar) - Action 1 (protect upmigrating delta smelt) - once turbidity or salvage trigger has been met, -2000 cfs OMR for 14 days to reduce flows towards the pumps. Action 2 (protect delta smelt after migration prior to spawning) - OMR range between -1250 and -5000 cfs determined using adaptive process until spawning detected. pp.280-282
76	USFWS	OMR	USFWS OCAP Bio Opinion - RPA re: OMR flows. Component 2 - Larvae/Juveniles - action starts once temperatures hit 12 degrees C at three delta monitoring stations or when spent female is caught. OMR range between -1250 and -5000 cfs determined using adaptive process. OMR flows continue until June 30 or when Delta water temperatures reach 25 degrees C, whichever comes first. pp. 280-282
77	CDFG	OMR	Longfin Smelt Incidental Take Permit (2009), p. 9-10, Condition 5.1. This Condition is not likely to occur in many years. To protect adult longfin smelt migration and spawning during December through February period, the Smelt Working Group (SWG) or DFG SWG personnel staff shall provide OMR flow advice to the Water Operations Management Team (WOMT) and to Director of DFG weekly. The SWG will provide the advice when either: 1) the cumulative salvage index (defined as the total longfin smelt salvage at the CVP and SWP in the December through February period divided by the immediately previous FMWT longfin smelt annual abundance index) exceeds five (5); or 2) when a review of all abundance and distribution survey data and other pertinent biological factors that influence the entrainment risk of adult longfin smelt indicate OMR flow advise is warranted. Permittee shall ensure the OMR flow requirement is met by maintaining the OMR flow 14-day running average is no more negative than -5000 cfs and the initial 5-day running average is not more negative than -6250 cfs. During any time OMR flow restrictions for
77 cont	CDFG	OMR	the FWS's 2008 Biological Opinion for delta smelt are being implemented, this condition (5.1) shall not result in additional OMR flow requirements for protection of adult longfin smelt. Once spawning has been detected in the system, this Condition terminates and 5.2 begins. Condition 5.1 is not required or would cease if previously required when river flows are 1) > 55000 cfs in the Sac River at Rio Vista; or 2) > 8000 cfs in the SJ River at Vernalis. If flows go below 40000 cfs in the Sac River at Rio Vista or 5000 cfs in the SJ River at Vernalis, the OMR flow in Condition 5.1 shall resume if triggered previously. Review of survey data and other pertinent biological factors that influence the entrainment risk of adult longfin smelt may result in a recommendation to relax or cease an OMR flow requirement.

Appendix A, Table 7. Notes for Tables 1 through 6.

No.	Entity	Type	Notes (excerpts from source documents)
78	CDFG	OMR	Longfin Smelt Incidental Take Permit (2009), p. 10-11, Condition 5.2. To protect larval and juvenile longfin smelt during Jan-June period, the SWG or DFG SWG personnel shall provide OMR flow advice to the WOMT and the DFG Director weekly. The OMR flow advice shall be an OMR flow between -1250 and -5000 cfs and be based on review of survey data, including all of the distributional and abundance data, and other pertinent biological factors that influence the entrainment risk of larval and juvenile longfin smelt. When a single Smelt Larval Survey (SLS) or 20 mm Survey sampling period results in: 1) longfin smelt larvae or juveniles found in 8 or more of the 12 SLS or 20mm stations in the central and south Delta (Stations 809, 812, 901, 910, 912, 918, 919) or, 2) catch per tow exceeds 15 longfin smelt larvae or juveniles in 4 or more of the 12 survey stations listed above, OMR flow advice shall be warranted. Permittee shall ensure the OMR flow requirement is met by maintaining the OMR flow 14-day running average no more negative than the required OMR flow and the 5-day running average is within 25% of the
78 cont	CDFG	OMR	required OMR. This Conditions OMR flow requirement is likely to vary throughout Jan through June. Based on prior analysis, DFG has identified three likely scenarios that illustrate the typical entrainment risk level and protective measures for larval smelt over the period: High Entrainment Risk Period: Jan - Mar OMR range from -1250 to -5000 cfs; Medium Entrainment Risk Period: April and May OMR range from -2000 to -5000 cfs, and Low Entrainment Risk Period: June OMR -5000 cfs. When river flows are: 1) greater than 55000 cfs in the Sac River at Rio Vista; or 2) greater than 8000 cfs in the SJ River at Vernalis, the Condition would not trigger or would be relaxed if triggered previously. Should flows go below 40000 cfs in Sac River at Rio Vista or 5000 cfs in the SJ River at Vernalis, the Condition shall resume if triggered previously. In addition to river flows, the SWG or DFG SWG personnel review of all abundance and distribution survey data and other pertinent biological factors that influence the entrainment risk of longfin smelt may result in a recommendation by DFG to WOMT to relax or cease an OMR flow requirement.
79	CDFG	Floodplain	DFG_Closing: DFG Exhibit 1, Page 13. Sacramento Splittail - floodplain inundation (habitat) - incubation, early rearing, egg and larval habitat and survival
80	USFWS	Floodplain	USFWS testimony concerning scientific information used to determine flow criteria. Source: U.S. Department Of the Interior - Comments Regarding the California State Water Resources Control Board's Notice of Public Informational Proceeding to Develop Delta Flow Criteria for the Delta Ecosystem Necessary to Protect Public Trust Resources, Sections II and III, pages 28 and 54. "The Board should consider the importance of more frequent floodplain inundation (especially Yolo Bypass flows) when determining the Delta outflows needed to restore the Delta ecosystem pursuant to the Board's public trust responsibilities" (p.28). "The Yolo Bypass floods via the Fremont Weir when flows on the Sacramento River exceed approximately 70,000 cfs, which it currently does in about 60% of years (Feyrer, et al. 2006). Flows on the Sacramento River should therefore exceed 70,000 cfs in at least six out of ten years. Recent historical floodplain inundation events are shown in Figure 4 (Sommer et al., 2001)" (p.54).

Appendix A, Table 7. Notes for Tables 1 through 6.

No.	Entity	Type	Notes (excerpts from source documents)
81	NMFS	Floodplain	NMFS OCAP Bio Opinion, Action I.6.1 - Restoration of Floodplain Rearing Habitat. p.608. " Objective: To restore floodplain rearing habitat for juvenile winter-run, spring-run, and CV steelhead in the lower Sacramento River basin. This objective may be achieved at the Yolo Bypass, and/or through actions in other suitable areas of the lower Sacramento River. Action: In cooperation with CDFG, USFWS, NMFS, and Corps, Reclamation and DWR shall, to the maximum extent of their authorities, provide significantly increased acreage of seasonal floodplain rearing habitat, with biologically appropriate durations and magnitudes, from December through April, in the lower Sacramento River basin, on a return rate of approximately one to three years, depending on water year type. In the event this action conflicts with Shasta Operations Actions I.2.1 to I.2.3., the Shasta Operations Actions shall prevail." By December 31, 2011, Reclamation and DWR shall submit to NMFS a plan to implement this action.
82	NMFS	Floodplain	NMFS - Public Draft Recovery Plan for the ESUs of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the DPS of Central Valley Steelhead (October 2009), Section 1.5.5, p.157. "Enhance the Yolo Bypass by re-configuring Fremont and Sacramento weirs to: (1) all for fish passage through Fremont Weir for multiple species; (2) enhance lower Putah Creek floodplain habitat; (3) improve fish passage along the toe drain/Lisbon weir; (4) enhance floodplain habitat along the toe drain; and (5) eliminate stranding events;and (6) create annual spring inundation of at least 8000 cfs to fully activate the Yolo Bypass floodplain."
83	D1641	DCC	For the May 21 - June 15 period, close the Delta Cross Channel gates for a total of 14 days per CALFED Ops Group. During the period the DCC gates may close 4 consecutive days each week, excluding weekends
84	Draft D1630	DCC	When monitoring indicates that significant numbers of salmon smolts or striped bass eggs and larvae are present or suspected to be present, the Executive Director (ED) or his designee shall order USBR to close the gates. The ED, with advice from other agencies, will develop specific monitoring and density criteria for closing and opening the gates.
85	CSPA / C-WIN	DCC	CSPA_Exh1_Jennings, C-WIN closing comments. Source CDFG_1992_WRINT-DFG-Exhibit #8, Alt C (p10). Function: reduce entrainment of Sacramento salmon smolts into the interior Delta
86	NMFS	DCC	NMFS OCAP Bio Opinion, Action Suite IV.1 (pp. 631-640)
87	EDF / Stillwater	Ouflow	EDF_Closing Comments (Table 1) - Mean Historical Delta Outflow Volumes (TAF) for 1956-2003 by month and water year type. Historical and unimpaired flow values are based on Water Years 1956-2003 using California Central Valley Unimpaired Flow Data, 4th ed. (CDWR 2007). In instances where there was a difference between Dry and Critically Dry years, the value for Critically Dry years was selected. Originally reported as volume (TAF). Conversion calculated as follows: (TAF/month)(1000 AF/TAF)(43560 ft3/AF)(month/X days)(day/86400 sec)

Appendix B: Enacting Legislation

California Water Code, Division 35 (Sacramento-San Joaquin Delta Reform Act of 2009), Part 2 (Early Actions), Section 85086

(a) The board shall establish an effective system of Delta watershed diversion data collection and public reporting by December 31, 2010.

(b) It is the intent of the Legislature to establish an accelerated process to determine instream flow needs of the Delta for the purposes of facilitating the planning decisions that are required to achieve the objectives of the Delta Plan.

(c)

(1) For the purpose of informing planning decisions for the Delta Plan and the Bay Delta Conservation Plan, the board shall, pursuant to its public trust obligations, develop new flow criteria for the Delta ecosystem necessary to protect public trust resources. In carrying out this section, the board shall review existing water quality objectives and use the best available scientific information. The flow criteria for the Delta ecosystem shall include the volume, quality, and timing of water necessary for the Delta ecosystem under different conditions. The flow criteria shall be developed in a public process by the board within nine months of the enactment of this division. The public process shall be in the form of an informational proceeding conducted pursuant to Article 3 (commencing with Section 649) of Chapter 1.5 of Division 3 of Title 23 of the California Code of Regulations, and shall provide an opportunity for all interested persons to participate. The flow criteria shall not be considered predecisional with regard to any subsequent board consideration of a permit, including any permit in connection with a final BDCP.

(2) Any order approving a change in the point of diversion of the State Water Project or the federal Central Valley Project from the southern Delta to a point on the Sacramento River shall include appropriate Delta flow criteria and shall be informed by the analysis conducted pursuant to this section. The flow criteria shall be subject to modification over time based on a science-based adaptive management program that integrates scientific and monitoring results, including the contribution of habitat and other conservation measures, into ongoing Delta water management.

(3) Nothing in this section amends or otherwise affects the application of the board's authority under Part 2 (commencing with Section 1200) of Division 2 to include terms and conditions in permits that in its judgment will best develop, conserve, and utilize in the public interest the water sought to be appropriated.

(d) The board shall enter into an agreement with the State Water Project contractors and the federal Central Valley Project contractors, who rely on water exported from the Sacramento River watershed, or a joint powers authority comprised of those contractors, for reimbursement of the costs of the analysis conducted pursuant to this section.

(e) The board shall submit its flow criteria determinations pursuant to this section to the council for its information within 30 days of completing the determinations.